Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLI. No. 8. NEW YORK, SATURDAY, AUGUST 23, 1902. ISSUED WEEKLY

ELECTRICAL REVIEW
PARK ROW BUILDING
13-21 PARK ROW - - NEW YORK
P. O. BOX 339

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY
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SUBSCRIPTIONS TO THE
ELECTRICAL REVIEW

One Year, United States and Canada	$3.00
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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

The approaching naval manœuvres will be watched with interest by all engineers, but more particularly by the electrical branch. Each year sees an extension of the use of electricity on shipboard, and every test which offers an opportunity of demonstrating its fitness for this class of work is awaited with confidence of a successful outcome.

The announcement that the President approves of the conditions presented for the laying of a Pacific cable is a welcome one. This will be, according to the specifications, a genuine American enterprise. It is to be hoped that there will not develop a single obstacle to the speedy completion of this important link in trans-Pacific commercial communication.

THE GAS TURBINE.

Now that the merits of the steam turbine have been fairly well recognized, engineers are turning their attention to the development of the gas turbine and with good hopes of ultimate success. While the reciprocating gas engine operating under proper conditions is probably the most efficient machine, so far as fuel consumption is concerned, for converting the stored energy of carbon into mechanical energy, it possesses certain disadvantages which to-day deter engineers from its more general use.

One of these objections is the relatively large size of the gas engine as compared with a steam engine of equal output. The gas engine is generally single-acting and has but one explosion every two revolutions, while the steam engine is double-acting, admitting steam twice every revolution. Therefore, the gas engine would have only one-fourth the capacity of a steam engine of the same dimensions if the latter worked through the same range of pressure. Since, however, the working range of pressure in the gas engine is much higher than in the steam engine, the actual performance is not so unfavorable and gas engines have come into extensive use where other considerations were involved in the selection.

Another disadvantage under which the reciprocating gas engine labors is the necessity of using water-jackets on the cylinder to ensure proper operation and sufficient lubrication, without which the life of the machine would be short. The temperature of the ignited gases is very high, so that the circulation of cooling water becomes necessary to keep the temperature of the cylinder low enough for successful operation. It has been stated that the heat carried off in the cooling water alone represents one-fifth of that delivered to the engine. In the steam engine, on the other hand, the cylinder is usually lagged with some non-conducting material to prevent, as far as possible, loss from radiation.

The third objection to the gas engine is the intermittent nature of the propelling force. In the steam engine, with conditions only one-fourth as bad, the parallel operation of alternators has given considerable trouble and been the subject of much discussion of late. To meet this condition gas engines are constructed with a liberal use of metal and very heavy fly-wheels. This construction, of course, steadies the speed of the engine, but it is very probable that it would not aid to any extent in preventing heavy cross-currents between paralleled alternators. It is generally accepted that it is desirable to keep the inertia of the moving parts as small as possible.

The steam turbine, on the other hand, can be made to possess just the qualities that the gas engine has not—large output, light weight, uniform angular velocity, absence of danger from high temperatures and no difficulty in lubrication. Further, if it is found possible to replace the steam with gas there will be no need of using cooling-jackets, and this great cause of loss will be eliminated.

Therefore, it is no wonder that certain eminent engineers have been attracted by the possibilities which the development of a satisfactory gas turbine offers.

The problem to be solved is that of producing a continuous combustion of gas under pressure and under complete control. While this appears difficult to-day, there seems to be little doubt of the ultimate success of this work, and when it has been accomplished the gain will be even greater than has been indicated above. It will mean an abandonment of one link in the chain of transformation as used to-day. The energy liberated in the furnace will be conducted at once to the prime-mover, doing away with the boiler and rendering the generating station independent of the water question.

It will mean that we will have made one step nearer the final goal, the direct conversion of the energy of coal into electrical energy.

TECHNICAL EDUCATION.

There is a danger which perhaps is not noticed to-day, but which should be recognized by the technical colleges and means taken to avoid unfortunate results. This danger, which is more apparent in the courses in electrical engineering, for reasons which will be mentioned later, lies in the tendency to take up long detailed studies of applied branches of engineering at the expense of pure science and mathematics.

This tendency to crowd in studies of applied electricity, for in this discussion electrical engineering alone will be considered, is a very natural one. There is a steadily increasing demand for young men with a technical training, and as the employers seldom understand the necessary conditions of college instruction, they expect the graduate to have some practical knowledge of every branch of the subject. Naturally the electrical departments make an effort to meet this demand.

Now, with a subject as broad as electrical engineering and which moreover is expanding with such unprecedented rapidity, it is even to-day impossible in the short time allotted strictly to this subject to do justice to all branches.

Another cause for this tendency to extend the study of practice at the expense of theory is the demand of the students themselves. There is a general feeling among electrical students that they are held back in their own subject more than is necessary. Mechanical engineering students begin with shopwork in the first year; civil engineering students usually take up surveying in the second year of the college course, while the electrical students do not get into their particular line of work until the third year, and then only to a limited extent, for unfortunately the electrical students do not consider physics and mathematics as their particular subjects.

This feeling of the students is only natural, but is nevertheless to be regretted, as it can not fail to have some effect upon the plans of the department.

Another point which helps to make the problem of a proper distribution of time more difficult in the electrical courses is the fact that electrical students usually devote more time to other technical subjects than do other technical students to electrical engineering. This is a good thing in itself, but of course reduces the time available for their own subject.

Several ways out of the difficulty may be suggested, though none of these is free from some objection. One would be to differentiate the work and offer specialized courses. To do this properly would require that each branch of applied electrical engineering be under the direction of a specialist in that line of work, and it is doubtful if there are many colleges which could afford to carry this policy out as thoroughly as could be desired. Moreover, engineering courses have frequently been charged with being narrow, and this method would still further restrict the student's study.

An alternative course open to the colleges is to come out flatly with the statement that they turn out trained thinkers, men who know the theory and have the use of that most powerful of all tools, mathematics. It is a notorious fact that one year's training in calculus does not give a student command of this invaluable servant. As has been stated again and again, the college graduate is not an engineer and can only become one through actual experience in practical work. It would seem, therefore, that practice could be learned best in the school of the world, and, on the other hand, theory is best learned at college. Few men can work all day and study to the best advantage at night.

It is not the intention to infer that no study of applied subject should be given. The more practice that can be studied advantageously the better able will the young man be to make his way. But theory should not be sacrificed for the study of practice which will probably be changed within a year or so.

To meet the demands for so-called practical men, electrical artisans we may call them, there are a number of good schools which are turning out this class of men.

The training of the engineer, however, should be broad and sound. No matter how well posted he is in his own line of work, he will find himself seriously handicapped if he knows nothing else.

DEPRECIATION IN TELEPHONE PROPERTY.

A very careful study of the always vexatious question of depreciation will be found in the serial now appearing under the above title in the ELECTRICAL REVIEW.

In this Mr. Fred de Land takes issue with the resolution adopted by the convention of the Interstate Telephone Association, which was held in Chicago last April, which was as follows:

"*Resolved*, That it be the sense of this convention that the depreciation in a well-constructed and well-engineered telephone plant should not exceed five per cent per annum."

The first point made by Mr. de Land is that depreciation signifies more than maintenance and repairs, and that it should include a constant charge against the property, since this will have to be replaced eventually by later and better apparatus, and that a figure of ten per cent would be nearer the proper value. To back up this opinion Mr. de Land presents testimony from telephone engineers of national reputation and quotes an opinion from the Supreme Court of the United States, which sanctions the including in operating expenses of proper charges to cover the lessening in value through depreciation.

Mr. de Land's arguments will doubtless be closely followed by all interested in electrical plants, although he here confines himself to telephone installations.

The remarkable increase in the use of aluminum during the last ten years is shown by the chart of mineral products of the United States, just issued by the Geological Survey at Washington. In 1891 the output was 259,885 pounds. In 1901 it was 7,150,000 pounds. These figures indicate how important this metal has become in the arts.

GYROSTATIC ACTION AND ITS BEARING ON CERTAIN POINTS OF ENGINEERING DESIGN.*

BY W. R. KELSEY, B.Sc.

The gyrostat in its most usual form consists of a disc, the axis of which is

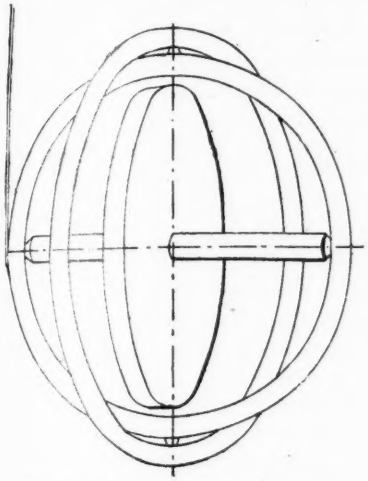


FIG. 1.—USUAL FORM OF GYROSTAT.

carried by gymbals (Fig. 1), which permit rotation of the disc about its axis in any plane. As thus made it possesses the remarkable property of apparently defying the force of gravity and contradicting Newton's law as to the equality and opposition of action and reaction. For if the disc be set swiftly rotating in a vertical plane, and the whole contrivance be suspended from a point on the inner ring, as in Fig. 1, the centre of mass does not, as in ordinary cases, fall to a position vertically below this point. On the contrary, the axis remains almost horizontal, but the whole thing rotates slowly in a nearly horizontal plane, moving more rapidly and sinking only when the disc slows down. Again, when the disc is rotating, if either ring be turned, a force rotating the other in a perpendicular direction is the general result.

Though these actions are widely known, elementary explanations of their cause have not been often published; indeed, the fact of the gyrostat affording an excellent example of the application of the Lagranian equations and cyclic coordinates appears to have usually protected it from meaner methods of attack, though quite susceptible of simpler treatment. Reduced to its simplest form, the point to be investigated is the nature and magnitude of the forces called into action when the plane of rotation of a revolving mass is turned through any angle. Considering, then, a body rotating about an axis, $o\ o$ (Fig. 2), with velocity $\theta - \theta'$ and θ', denoting respectively angular velocity, and acceleration, with similar symbols for other angles, let AA′ represent the circular path of any point in it. If the axis be rotated with a velocity ϕ', the plane of the body's rotation at the end of a short time $d\ t$ will have turned, through an angle $\phi'\ d\ t$, and the path of the point may be represented as AB, the angle $\phi'\ d\ t$ being shown large for clearness, but in reality being infinitesimally small. But by the ordinary rule for resolving vector quantities a rotation θ' in the plane AB is equivalent to a rotation $\theta' \cos(\phi'\ d\ t)$ in the original plane, AA′, and another $\theta' \sin(\phi\ d\ t)$ in the perpendicular plane, AC. This, indeed, is obvious when ϕ' is less than θ' for the intersections of projected points on AA′ and AC reached simultaneously when the respective velocities, as stated, lie upon AB. (The motion is equivalent to these components, not actually their resultant. The actual path traversed by a point performing rotations in perpendicular planes with velocities ω and ω' is given by an equation of the form

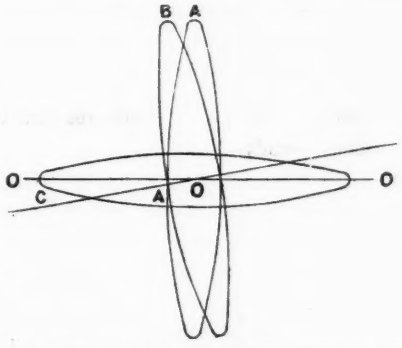


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF BODY ROTATING ABOUT AN AXIS.

$$x = R(\cos \omega\ t + \cos \omega - t),$$
$$y = R \sin \omega\ t,$$
$$z = R \sin \omega'\ t,$$

a screw-like kind of curve on a circular pitch line.) During the interval $d\ t$, therefore, the body has acquired a velocity $\theta' \sin(\phi'\ d\ t)$ in the plane AC—that is, an angular acceleration Ψ'' equal to $\frac{\theta' \sin(\phi'\ d\ t)}{d\ t}$ has been in operation. It is simpler to consider the angular momentum impressed on it in this plane; and this, if its moment of inertia about the centre of rotation be denoted by I, is $I\ \theta' \sin(\theta'\ d\ t)$. But angular momentum equals the product of the torque and time, hence the corresponding torque is equal to $\frac{I\ \theta' \sin(\phi'\ d\ t)}{d\ t}$; or, since $d\ t$ is a very short time, to $I\ \theta'\ \phi'$. Though this torque is indirectly impressed, the body exerts a direct reaction, and produces an equal torque on the axis in a counter-clockwise direction in the plane AC perpendicular to that in which the axis is rotated. If motion under this torque is prevented, the torque applied to the axis originally to produce the velocity ϕ' is precisely the same as if the body were at rest in the plane of θ; or, excepting the initial acceleration, is simply equal to the frictional resistance opposing ϕ'.

If the axis $o\ o$ is free to rotate under the torque $I\ \theta'\ \phi'$, let the moment of inertia of the body about the new axis of rotation be I′, and let Ψ' denote angular velocity in the plane AD. Then

$$I\ \theta'\ \phi'\ d\ t = I'\ \Psi''\ d\ t,$$

and at the end of the period $d\ t$

$$\Psi'' = \frac{I}{I'}\ \theta'\ \phi',$$

but, reciprocally, this rotation of the axis gives rise to a torque, $I\ \theta'\ \Psi'$, in the plane of θ and opposing θ'. Hence the torque necessary to produce the rotation θ' is now, neglecting friction, $I'\ \theta'' + I\ \theta'\ \Psi'$, or substituting for Ψ', $I'\ \theta'' + \frac{(I\ \theta')^2\ \phi'}{I'}$

If the axis $o\ o$, instead of rotating in a plane, be constrained to do so about the axis o A′ under the component of the torque $I\ \theta'\ \phi'$, the torque impressed on it in the plane of θ is now

$$I'\ \theta'' - I'\left(\frac{I}{I'}\theta'\ \phi'\right)^2 \sin\theta \cos\theta + \frac{(I\ \theta')^2\ \phi'}{I'}$$

and the small effect of gravitation when the body was suspended, as in Fig. 1, becomes intelligible.

It is evident that the torque $I\ \theta'\ \phi'$ may become extremely great, if I or θ' be sufficiently large, for even small values of ϕ'; and in the case of high-speed machinery on shipboard the stresses so produced

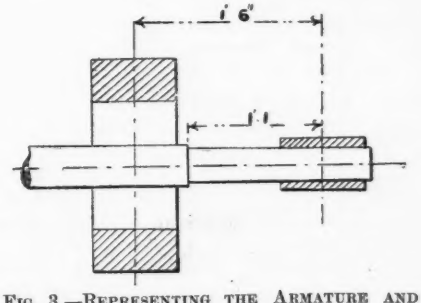


FIG. 3.—REPRESENTING THE ARMATURE AND OUTER BEARING OF A DYNAMO.

are by no means always negligible. In the main engines, as also in those driving fans, pumps and refrigerators, either the speed or the moments of inertia are relatively small, but in the electric plant the speed is generally high and the moment of inertia of the armature considerable. If, for example, the armature and outer bearing of a dynamo be as in Fig. 3, and the former be rotating at 400 revolutions per minute, θ' is $\frac{2\ \pi\ 400}{60}$, or 420, and I is

*From the *Electrical Engineer*, London.

approximately 32.5 pound-feet. The value of the moment of inertia, I, may be approximately found by multiplying the mass of the core and winding—*i. e.*, its weight in pounds divided by 32, by the square of the mean radius from the centre line of the spindle.

In estimating ϕ', which must be taken here as the maximum angular velocity which may be impressed on the vessel, some experience of the class of ship is necessary; the natural period of its motion would give only a small value, but as the dynamo shaft usually runs fore and aft, the greatest angular velocity and stress would arise if the head or stern were struck to starboard or port by an oblique sea. The value of ϕ' due to this cause would probably on occasions be considerable. Taking ϕ' as 0.09 per second, the torque tending to rotate the shaft in a vertical plane round the centre of the armature is

$$32.5 \times 420 \times 0.09 = 1,230 \text{ pound-feet.}$$

Regarding this as opposed by equal forces on each end of the shaft, the increase of pressure on the bearing is $\frac{615}{1.5}$, or 410 pounds, and the increase of bending stress at the shoulder between commutator and armature is $410 \times 13 = 5,330$ pounds.

An example coming under the writer's notice was that of a flywheel 4 feet in diameter, 8 inches wide, 5 inches deep in the rim, rotating at 300 revolutions per minute. Here θ' is 31.5 and I about 100,000 inch-pounds. Taking ϕ' at 0.09, as before, the torque is $100,000 \times 31.5 \times 0.09 = 234,000$ inch-pounds. In this case the armature spindle was restrained from longitudinal movement only by the coupling bolts, and the wheel was driven from a web between the coupling flanges. The average distance of the coupling bolts from the axis of gyrostatic rotation was 4.5 inches, and consequently the tension on them would be 21,000 pounds were it not for the resistance to crushing of the metal of the boss into which the flanges were recessed about an inch; as this, however, was an easy fit, the relief afforded by it is uncertain.

It thus appears that, apart from its curious action and theoretical interest, gyrostatic forces may attain magnitudes not unworthy of attention by the designers of machinery subject to its influences.

It is reported that successful experiments in the application of wireless telegraphy to submarine by a system invented by Lieutenant Tadie have recently been made at Cherbourg. A mast with receivers was fixed to a submarine, and the vessel, after submersion, received signals transmitted from the central submarine station with perfect clearness.

A Sydney Bridge.

What London Bridge, with its many historic associations, is to the British metropolis, Pyrmont Bridge is to the capital of New South Wales, each uniting a couple of densely populated shores separated by a wide expanse of water; the River Thames in the one instance, and by a broad arm of Sydney Harbor in the other. Previous to 1857 communication between the two Sydney shores was conducted by means of ferry and rowboats, but in that year a wooden bridge, constructed by private enterprise at a cost of £75,000, was opened, a toll being levied on each passenger, vehicle or animal crossing. There was a swing span in the centre to allow masted vessels to pass through, the lowness of the bridge proving a barrier to the passage otherwise of even small steamers, the result being that the stream of bridge traffic was constantly being interrupted to allow the swing span, worked by mechanical power, being used. In 1884 the bridge was purchased for the sum of £40,000 by the state government, and the tolls abolished. This was followed by such a rapid expansion of passenger and vehicular traffic that a new bridge became indispensable, and, after various preliminaries, competitive designs were invited from various parts of the world, that obtaining the first premium being estimated to involve a cost of £295,700. Ultimately it was arranged that the new bridge should be constructed from designs prepared by Mr. Percy Allan, M. Inst. C. E., one of the engineers in the state department of public works and an Australian by birth, a commencement being made with the actual work in September, 1899, and the structure formally opened on June 28, 1902, by Sir Harry Rawson, the State Governor, assisted by the Hon. E. W. O'Sullivan, State Minister for Public Works. The new bridge is one of the largest and most substantial yet constructed in the Commonwealth, and the experience gained during the progress of the work will naturally be utilized in connection with the proposed construction of the immense bridge across Sydney Harbor. The total length of the Pyrmont Bridge and its approaches is 1,758 feet, the bridging occupying 1,200 feet, of which 223 feet represent the length of the swing span. The area of the latter 12,000 superficial feet, compares favorably with the 10,600 feet of the Newcastle-on-Tyne bridge swing, the 9,400 feet of the swing bridge in connection with the Manchester Ship Canal and the 8,700 feet of the bridge swing at Hawarden. There may be larger bridge swings in the United States, but none constructed in a manner more up to date than that at Pyrmont. The heaviest work was in connection with the sinking of the caisson forming the main support of the bridge swing. This huge chamber, having a diameter of forty-two feet, was commenced on August 2, 1900, and a few weeks later was completed sufficiently to permit of its being grounded, by means of girders and wedges, in the position it was intended to permanently occupy. Then it was gradually worked down a depth of forty-six feet below low-water mark, at which point the cutting edge touched rock on one side. The necessary damming having been completed, the water was pumped out and excavations carried on in the "dry" until a "blow" occurred, when the work had to be continued with the surface of the rock under water. The caisson, when the work of sinking had been completed, was filled with a solid mass of stone and concrete representing a dead weight of over 6,800 tons. Electricity supplies the motive power for working the bridge swing, its slewing, the lifting of the ends, the operating of the gates closing the traffic and the lighting of the roadway being controlled by a man stationed in a conning tower on the centre of the bridge. So perfect are the arrangements that by simply pressing a button the bridge—weighing 800 tons—can be opened or closed in forty-four seconds. Both the slewing and lift motors are carried on a platform inside the drum, the former working through a train of gears a vertical shaft, on the lower end of which is a cast-steel pinion meshing, with a cast-steel rack secured to the top of a pivot pier, while the end lift is effected by means of cones on horizontal shafts worked by a 35-horse-power motor gearing on to a longitudinal shaft running the whole length of the bridge span. The materials used in the latter were iron and stone, Australian hardwood being largely employed in the construction of the other spans, twelve in number, each having a length of eighty-two feet; while the roadway, which is four feet wider than that of the Tower Bridge, London, is asphalted. The estimated cost of the structure, which possesses a substantial, yet not ungraceful appearance, is £112,000, against £295,700, the estimated cost of the design obtaining the first premium in the competition open to the world, although the necessary works were on a more extended scale.

An Electrical Rat Trap.

"I had a very unusual trouble once," said an electrical construction man, "that kept all hands at the station guessing for more than a month.

"We had installed an underground cable system in an Ohio town for supplying light by means of a 2,000-volt alternating-current system, placing our transformers, as a rule, on the outside basement walls. Shortly after the plant was put into operation our station man reported one morning that there appeared to be a swinging ground on the line for a short time, so much so, he said, as to send the station ammeter far beyond its usual load. Well, we made all the usual tests, but could find nothing wrong and it was several days before we heard anything more from it when all at once it came back one night and again disappeared within a few seconds as before.

"As we had some overhead wire I sent a man out to look for a guy wire contact, but none was found. Then I sat up for several nights myself watching for it without result, as it did not appear, but the first night I left the station it was reported again and a few days later it happened while I was in the station, but before I could get to the board to open the switches and so find out which circuit it was on, it was gone and the line once more clear; and so it went on for two weeks more.

"By this time one of the lines began to show considerable leakage and I tried to locate the trouble, which work, however, was interrupted by the dynamo starting up. That night, however, our regular chronic trouble came on again and this time remained on instead of clearing itself as the others had done, and a quick opening of switches showed that it was on the same circuit we had tested during the day. Well, we kept the circuit going until morning and then started out to find the trouble. By very careful testing we soon traced it to a certain rather old factory building. Going inside we tested the transformer, but that was all right, but there was a ground between the transformer and the street, so that we followed the primary cables in that direction, which passed through an unused coal and junk room. As soon as we entered the place, where it seems no one else ever thought of going, we were greeted by an odor that was suffocating, and near the pipe entrance leading to the street we found a pile of decomposed and decomposing rats.

"We called the janitor, got them out of doors as quickly as possible, and then the cause of our trouble was plainly apparent, for every rat was more or less burned.

"But how? Going back to the cellar we found one rat still lying across our cables, burned to a crisp. Looking at the cables again we found them gnawed through in more than a dozen different places. Now what had induced those rats to climb up there and gnaw through that lead cable and electrocute themselves?

"I put this question to a naturalist who lived in the city, who explained it by saying that probably the rats, being very keen of hearing, had noticed a slight hum from the alternating-current cables, and, imagining that the pipes contained running water, gnawed through the lead sheathing and rubber insulation until they reached the copper wire, when they would be killed, and, without making even a sound to warn others, drop to the floor below."

Electric Glass Works.

Glass works, in which the glass is smelted with the aid of the electric current, will be opened at Deutsch Matrei, in Tyrol, in the course of this year, by the Aktien-Gesellschaft für Elektrokeramik. These will not exactly be the first electric glass works; for, apart from experimental plants, glass has been manufactured electrically for some time at Plettenberg, situated on the Lenne, in Westphalia, where 2,000 horse-power—three-quarters water power, the rest steam—are available. But the Matrei works are the first especially built for the electric manufacture of glass. Successful experiments on glass smelting by the electric arc seem first to have been made by F. H. Becker, a glass manufacturer of Cologne, in 1898, though there were laboratory trials earlier. The suitability of the electric arc was not so far doubtful, as the heat must not be too intense, lest devitrification result, nor of too short a duration. Becker therefore arranged his arcs in steps, usually in three, on an inclined plane, each step representing a crucible from which the glass flowed into a receptacle which was heated by coal or producer gas. This combination of electric and ordinary heating was not satisfactory. Means were, however, found of combining the receptacle with the cooling furnaces, which were anyhow to be heated by coal or gas. Völker, also of Cologne, with whom Becker associated himself, made other suggestions, which have likewise been adopted in practice at Plettenberg. Since the fused glass is a conductor of electricity, he provided electrodes on both sides of the receptacle, and kept the mass in flow for some time in this manner. To avoid any contamination of the glass with the carbon of the electrodes and its impurities, he placed the electrodes behind perforated diaphragms. Alternating currents are exclusively used in this system of glass smelting, though the patents are not restricted to their use. Völker also made briquettes of the materials and of carbon so as to melt the glass, not by the arc, but direct in a circuit of high resistance. Certain kinds of glass plates are produced in this manner. When the experiments had been continued for about a year, the Industrie Verrière et des Dérivés, of Brussels, took the matter up in conjunction with the Lenne Elektricitäts Werke, at Plettenberg. The *Zeitschrift für Electrochemie,* of June 26, states that a colorless glass is obtained at the latter place, on both the Becker and Völker systems. The economy of the electric production left at first a good deal to be desired. The kilogramme of glass was originally produced at an expenditure of four horse-power-hours; the current consumption has now been reduced to one and one-half and one and one-quarter horse-power-hours. As the electric furnaces are simpler and less expensive than the old furnaces, and possibly more durable, and as, further, the electric plant of new glass works would offer many other advantages, the new process may prove commercially successful. The Matrei Company will receive 3,000 electric horsepower from the Carbidwerke Deutsch Matrei, which are interested in the new concern, with which the firms and names previously mentioned remain connected. The unsatisfactory outlook of the carbide industry may have facilitated the establishment of this new company, which, as the name indicates, will not confine itself to glass-making, but take up keramic manufacture in general.—*Engineering* (London).

Loss of Life in the United States by Lightning.

From data in possession of the Weather Bureau it is shown that during the year 1900 713 persons were killed by lightning and 973 severely injured. Of the total number of 1,686, more than 500 were struck while "in the open" and nearly 300 of these were killed; 158 were killed in houses and 327 injured.

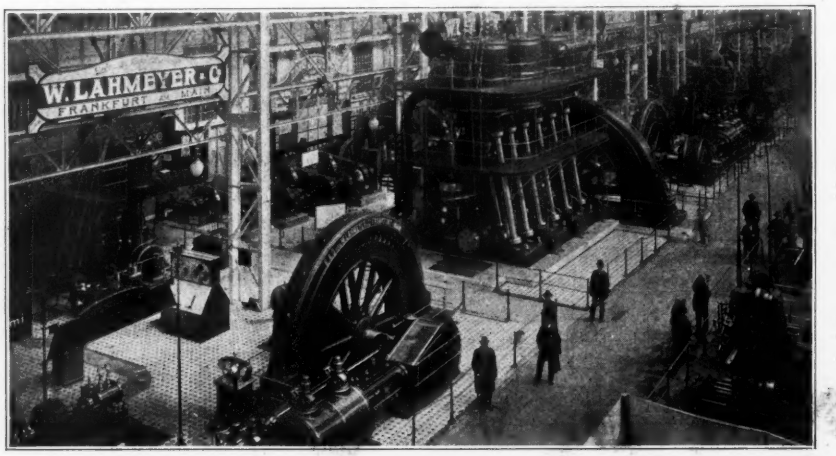
The greatest fatality of a single stroke occurred at Chicago where eleven boys and one man sought shelter under a shanty formed by some loose pieces of abandoned zinc thrown over the piles at the end of a pier. The shanty was struck and the man and ten boys instantly killed.

In Hayden's Book of Dates the largest fatality recorded is from a bolt that struck a church in the Alps in 1819 and killed nine persons.

Electrical Exhibits at the Dusseldorf Industrial Exposition.

By Frank C. Perkins.

TWO of the most important manufacturers exhibiting electrical apparatus at the Industrial and Trades Exposition of the Rhine Province, Westphalia and the neighboring districts in Germany, now being held at Dusseldorf, are the Deutsche Elektrizitäts-Werke, of Aachen, and the Elektrizitäts-Werke, formerly W. Lahmeyer & Company, of Frankfort-on-the-Main. This entire exposition is a striking illustration of the progress made in the German technical trade during the past decade. The great importance which the Rhine Province and neighboring provinces have acquired is largely in consequence of their highly developed mining industries, their first-class iron and engineering trades and the great rôle which electricity plays in all branches of these trades.



3,000-Horse-Power Vertical Triple-Expansion Engine, Operating 2,000-Kilowatt Polyphase Generator at 94 Revolutions per Minute, and at Potential of 5,000 Volts, Industrial and Trades Exposition, Dusseldorf, Germany.

The Deutsche Elektrizitäts-Werke, of Aachen, exhibit a large number of motors, transformers, direct-current generators and alternating-current generators of both single-phase and polyphase types. One of their large multipolar, direct-current machines is directly connected to a horizontal, tandem-compound engine, built by Maschinenfabrik Schuechtermann & Kremer, of Dortmund. This engine has a capacity of 300 effective horse-power at a speed of 100 revolutions per minute. The high-pressure cylinder has a diameter of 450 mm., while the low-pressure cylinder measures 700 mm. in diameter, the stroke being 900 mm. in length and the working pressure ten atmospheres. The exhibits of W. Lahmeyer & Company, of Frankfort-on-the-Main, are particularly interesting. One of the specialties of this firm, the applications of electric energy to mining and metallurgical purposes, strike the visitor's eye and are conspicuous by their number and great variety. Apart from the exhibits in their own pavilion and the vast group of machines in the large Machinery Hall, the manufactures of Messrs. Lahmeyer & Company are represented in nearly all the groups of the exhibition. Among the smaller machines exhibited by this firm in their pavilion is a group of motors and dynamos of both two and four-pole Lahmeyer type with radial poles and slotted armatures. Another group consists of alternating-current motors of both single-phase and three-phase machines, while another set includes a number of enclosed motors as well as those of the semi-enclosed form.

In the Lahmeyer pavilion there is also a very fine exhibit of transformers of different sizes and for different pressures up to 10,000 volts. A model of an underground transformer station shows how the transformers are fixed in the street shafts for electric central station work, regulating and controlling apparatus of all sizes and for the most varied purposes occupy a fair share of the room in the pavilion. The visitor's attention is first attracted by a series of crane controllers worked by so-called sympathetic movements of the levers. The working parts of the controllers are assembled in such a manner as to give a clear insight into the somewhat complicated construction of the controller, and at the same time showing that even the smallest part is worked with the utmost precision and accurately finished.

A group of starting and regulating switches and resistances is shown, as well as various forms of switchboards and different fittings for lifts and cranes. A most interesting exhibit of high-tension fuses illustrates a new departure in this class of apparatus, blowing off without any appreciable arc, even at the highest tensions.

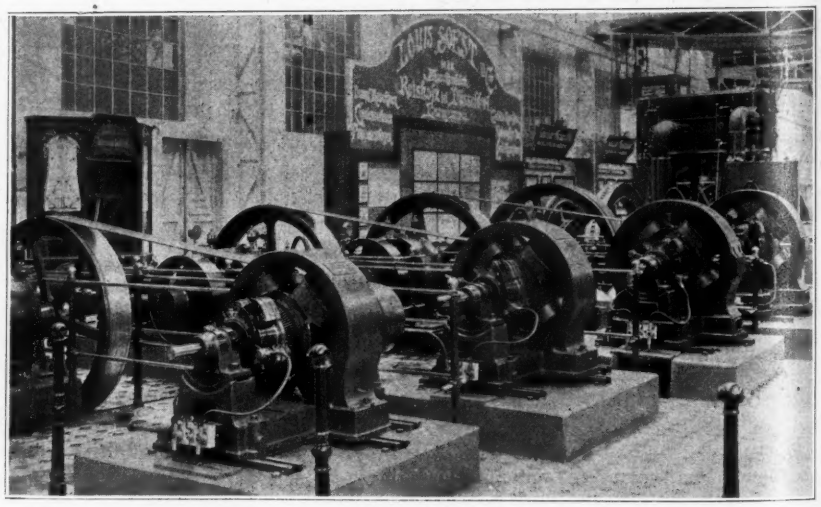
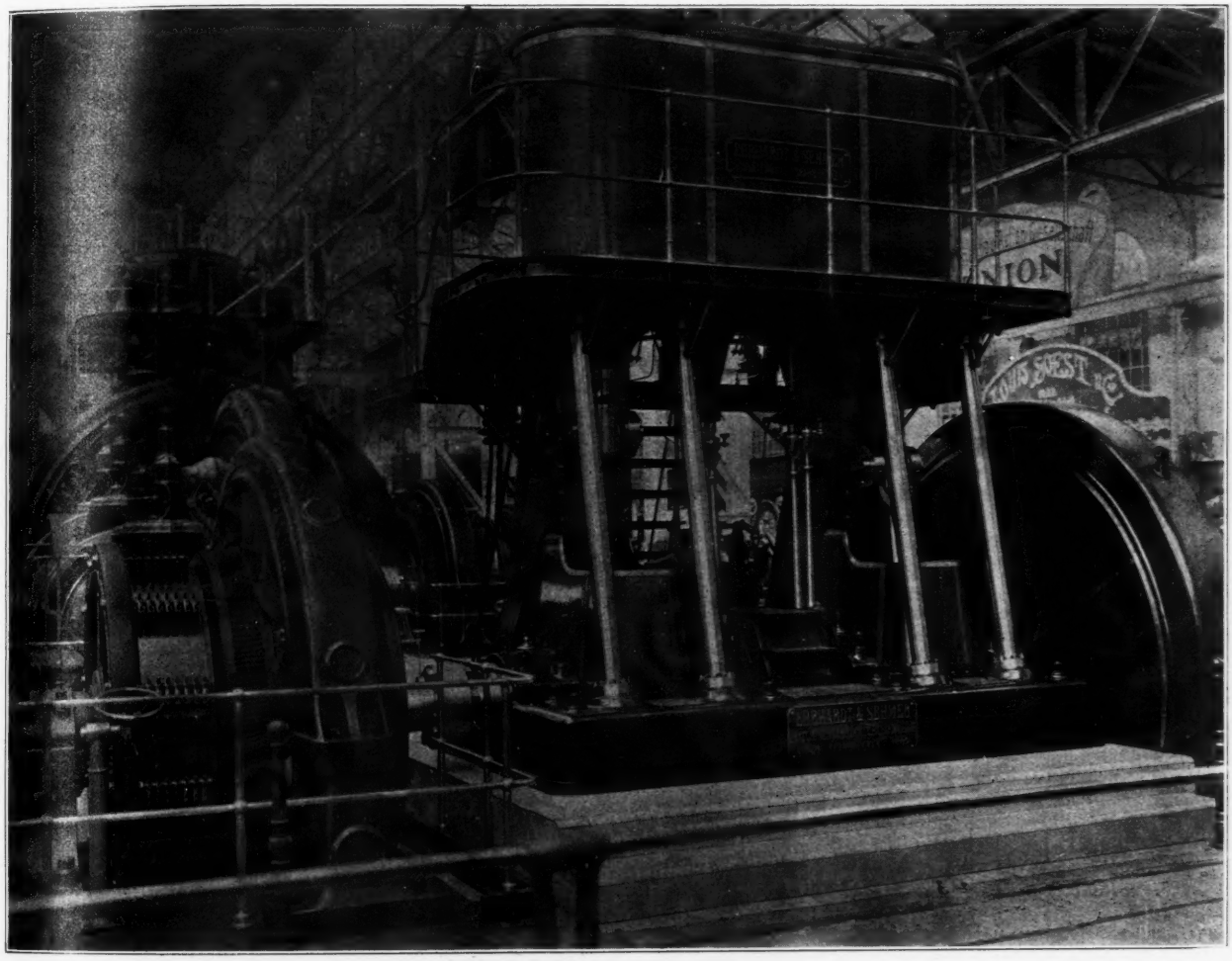


Exhibit of Engines Driving Direct-Current Generators, Industrial and Trades Exposition, Dusseldorf, Germany.

An electric elevator occupies one corner of the pavilion and is fitted with push-controlling apparatus; the small pushes enable the attendant to work the elevator from the different floors or from the elevator itself, and by merely pushing a button it may be worked from any one floor to another.

Some of the finest in the large Machinery Hall are in groups 4 and 5, representing the engineering and electrical trades. The electric central station, supplying the whole exhibition with electrical energy, is situated on the northern side of the hall. The total output of the electrical generators forming the power plant amounts to 13,000 horse-power, of which 8,500 horse-power is used for driving seventeen generators exhibited by Lahmeyer & Company, and it is stated that these seventeen dynamos could furnish the whole of the energy required at the exposition, which averages about 6,000 horse-power per day. One of the largest units is the 3,000-horse-power, three-phase generator, directly coupled to the vertical triple-expansion engine manufactured by the Gutehoffnungshütte. To the left of this large unit is a 500-kilowatt single-phase alternator, running at 10,000 volts. This generator furnishes the energy required for lighting the Rhine Bridge on festive occasions, and is driven by a horizontal tandem engine by the engineering works Humboldt. Proceeding in the same direction, the next set is a turbo-dynamo of novel design. The steam turbine, built by Wilhelmi, runs at 550-625 revolutions per minute, and is coupled direct to a continuous-current generator with an output of twenty kilowatts. A vertical steam engine, built by K. & T. H. Moeller, of Brackwede, I. W., and having a capacity of 330-475 horse-power, is directly coupled to a continuous-current generator with a capacity of 275 kilowatts, and a continuous-current flywheel generator for traction purposes is operated by direct-connection with a steam engine built by the Dingler Engineering Works, of Zweibruecken. This flywheel type of machine is a specialty of Messrs. Lahmeyer & Company, and was built by them on a very large scale. A number of belt-driven, continuous-current generators are also exhibited, driven by Bingler steam engines, varying from 20 to 100 horse-power in capacity.

Messrs. Neumann & Esser, of Aachen, have furnished a 200-horse-power engine, which is directly coupled to a 100-kilowatt direct-current dynamo, operating at a speed of 120 revolutions per minute, the potential being from 220 to 250 volts.



480-Horse-Power Vertical Compound Engine, Driving 275-Kilowatt, Multipolar, 220-Volt, Direct-Current Dynamo, at the Industrial and Trades Exposition, Dusseldorf, Germany.

Messrs. Soest & Company, of Dusseldorf, are showing an engine of 250-350 horse-power, driving a continuous-current machine of 185 kilowatts capacity and a pressure of 220 volts. The Maschinenbau A.-G. Union, of Essen, exhibits a 650-horse-power engine operating at ninety-four revolutions per minute. This engine drives a 440-kilowatt traction generator supplying a direct current of 600 volts.

The eastern corner is occupied by a direct-current dynamo having a capacity of 275 kilowatts, operated by a 400-horse-power steam engine built by Ehrherdt &

Schmer, of Schleifmuhle, and having a speed of 150 revolutions per minute.

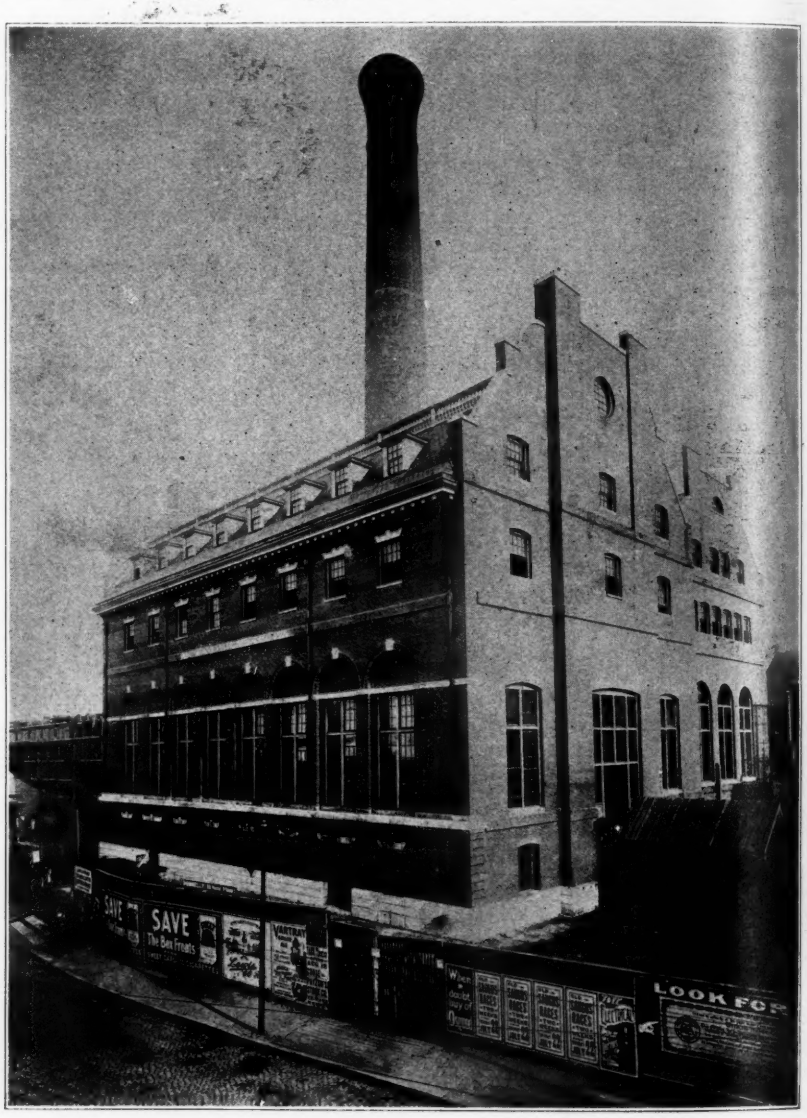
Between this dynamo and the 3,000-horse-power unit previously mentioned a large double dynamo has been located. This set is coupled to an engine built by Maschinenfabrik Hohenzollern, of Dusseldorf, and is especially interesting inasmuch as a direct and a three-phase current are simultaneously generated, totaling a joint output of 1,000 horse-power. The engine drives the dynamos at a speed of ninety-four revolutions per minute, the alternator generating a three-phase current at a potential of 5,000 volts and the direct-current machine supplying a continuous current of 600 volts. Louis Soest & Company, of Dusseldorf, also operate a high-speed steam engine directly coupled to a totally enclosed seventy-five kilowatt dynamo, this unit being located at the rear of the double generator above mentioned. All of these machines just described are shown at work and furnish part of the total energy required in the exhibition and grounds. The necessary switching and controlling, as well as the measuring instruments, are fixed in suitable positions near their respective machines. Messrs. Haniel & Lueg, of Dusseldorf, exhibit a number of very interesting and large machines, including an enclosed three-phase motor coupled to a centrifugal pump of the type used by the Imperial Shipyard at Kiel for use at the drydock. These have a rated capacity of 110 horse-power and operate at a speed of 165 revolutions per minute. Another important exhibit is a complete electric pumping plant, which consists of a generating station installed in practice above ground and a pumping station situated underground. The generating station includes a 1,000-horse-power Haniel & Lueg engine which operates by direct-connection a Lahmeyer high-tension three-phase generator at a speed of ninety-four revolutions per minute. The capacity of the generator is 750 kilowatts and the potential 3,000 volts. The pumping station consists of a slow-speed Haniel & Lueg pump, coupled direct to a Lahmeyer asynchronous three-phase motor. The pump can handle 5.5 cubic metres of water per minute against a head of 450 metres. The three-phase motor has a capacity of 650 horse-power at a potential of 2,000 volts and operates at a speed of sixty revolutions per minute. A large number of these slow-speed motors for pumping plants have been installed in the Rhine provinces and Westphalia and the experience gained in the use of these large high-tension motors is such as to warrant them entirely successful with the most severe conditions imposed by mining engineers, both regarding the safety of operation and the economical working of these important plants.

LINCOLN POWER STATION OF THE BOSTON ELEVATED RAILWAY.

The Lincoln station of the Boston Elevated Railway differs in many respects from the various other power stations of the same railway system. It is the most recent addition to Boston's numerous electrical power plants and is located on the lot known for many years as Lincoln Wharf. This location, on the water front of Boston Harbor, is in the heart of the old city, near the junction of Commercial street and Atlantic avenue, where there are excellent facilities for the docking of coal and other supplies. The general appearance of the building is imposing, the architectural design being notably fine. The massive chimney, extending to a height of 250 feet, and one of the first things to catch the eye, is said to be the tallest stack in the city. The building is divided into two longitudinal sections, the boiler room and all apparatus pertaining thereto being in one section and the engines, generators and condensing system in the other. The engine room is served by a large electric crane of forty tons capacity. The walls of this room are faced with white enamel brick, adding much to its general appearance and illumination.

The present station contains three units aggregating about 13,500 horse-power. While it is now complete in itself, ample ground area has been provided for the extension of the building and plant on harmonious lines to accommodate four additional units, thus permitting an ultimate equipment of about 30,000 horse-power.

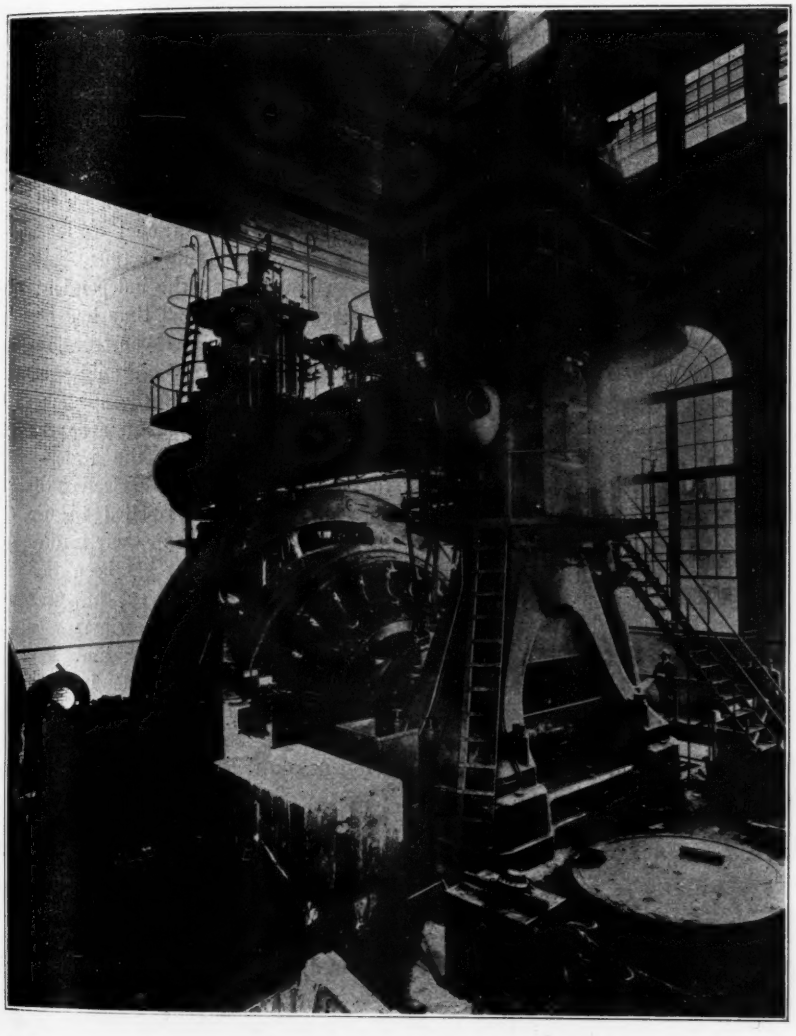
The boiler installation consists of eight 468-horse-power and four 490-horse-power Babcock & Wilcox boilers. An equipment of Roney mechanical stokers of the same type as those in the large power-houses



EXTERIOR OF LINCOLN POWER STATION, BOSTON ELEVATED RAILWAY.

in New York city has been installed by Westinghouse, Church, Kerr & Company.

Coal will be automatically unloaded from vessels and stored in a large pocket holding 5,000 tons, with a further storage bin of 3,000 tons in the boiler house, or a total storage capacity of 8,000 tons. It is carried to the boilers by a Hunt coal and ash conveying system which conducts the coal into overhead conveyors leading to the stokers, thus practically eliminating all manual labor in the handling of coal and ashes. The coal apparatus is so arranged that coal can be taken from the pocket to the storage bin in the boiler house and, in addition, tracks are located on either side so that coal cars can be automatically loaded to carry coal to the various other stations if desirable, *viz.*, to the Charlestown, Harvard, Allston and central stations, as well as to some thirty or more car houses situated in different parts of the city. The plant is equipped with Green economizers.



4,500-Horse-Power Vertical Compound Engine, Direct-Connected to 2,700-Kilowatt, Direct-Current Engine-Type Generator.

Feed water is supplied to the boilers by means of two vertical-compound pumps, manufactured by the George F. Blake Manufacturing Company. A Star vacuum feed-water heater of 8,000-horse-power capacity is placed on the base of the chimney conveniently near the feed pumps. As the smoke flues from the boilers enter the stack at a point some thirty feet from the boiler-room floor, the space in the lower part of stack has been found quite valuable for the location of such auxiliaries as feed-water heaters, receiver of the Holly gravity return system and sundry piping.

The original engine installation consisted of two vertical cross-compound units of 4,500 horse-power each, built by the Providence Engineering Company. The generator and flywheels are carried on the shafts between the high-pressure and low-pressure sides. The generators are direct-current machines, rated at 2,700 kilowatts each. A third unit which has just been completed consists of a vertical cross-compound engine of about 4,500 horse-power direct-connected to a Westinghouse direct-current generator of 2,700 kilowatts capacity of the same make and similar to one of the two machines mentioned above. The engine, however, differs considerably in design and construction from the two engines first installed. The high-pressure cylinder is fitted with poppet valves for use with superheated steam, which is supplied by superheaters built by the Babcock & Wilcox company.

This station is built upon land situated in the centre of Boston's most desirable wharf property, and the cost of the location was, presumably, high. Had it been necessary to use other than vertical engines, the amount of land required in such a valuable locality would have given rise to a serious financial problem.

The steam piping represents all that is modern in this important portion of the plant. Steam is conveyed from both sides of the boiler room by eight-inch mains to a sixteen-inch drum, from which it is conducted by twelve-inch risers to Cochrane receiver separators and thence to the engines. All the live steam drips from steam drums, separators and reheating receivers are carried back to the boilers by the steam loop and Holly gravity return system.

Ingersoll-Sergeant air compressors, each driven by a fifty-horse-power Westinghouse, 500-volt motor, supply compressed air for the block signal and switching system used by this road. Early in the conception of the scheme of running trains at high speed under the rather complex conditions here existing, the engineers of the Boston Elevated Railway realized that a block system was necessary as a safeguard against accident. After careful consideration the Westinghouse electro-pneumatic interlocking system, manufactured by the Union Switch and Signal Company, of Swissvale, Pa., was chosen. There were many reasons for this decision, among them being the quality and reliability of the material furnished and, again, the small space required for switch towers, signals and operating mechanism.

The elevated road includes some fourteen miles of trackage. The switches and signals are controlled from four switch towers, and the automatic block signals are located at distances of about 800 feet apart. Each tower is supplied with indicators showing the approach of trains. The towers at the junctions of the Atlantic circuit and main line control some 1,200 elevated trains daily. The largest tower is located at the Sullivan square terminal, where some 500 elevated trains and 700 surface cars pass in and out daily, involving 6,000 switch and signal movements. A force of only two men on duty is required to operate the switchboard mechanism, consisting of thirty-five pneumatic levers. The terminals are also supplied with lamp indicators showing the relative location of approaching trains. While the train movements at Sullivan square are not so complicated as those at the Boston south terminal railway station, the elevated railway company has less track room at its disposal and handles a much larger number of trains for a given number of tracks.

DEPRECIATION IN TELEPHONE PROPERTY—III.

A SERIES OF PAPERS ON AN IMPORTANT TELEPHONE PROBLEM.

BY FRED DE LAND.

Our third phase of depreciation is the lessening in value from excessive and unexpected growth making necessary the entire rebuilding of circuits and the entire replacement of equipment. Here is the pen picture of a writer in an independent telephone journal on this form of depreciation. "The telephone service has only quite lately begun to take its place among the people, and the rapid development which is just getting under way promises to swell the prodigious proportions in the near future. This development is accompanied by almost daily changes in business and technical methods, so that the whole industry is undergoing a transformation that makes telephone conditions of only a few years ago seem like the mustiest of ancient history." And the editor of that journal says: "Two years ago some telephone engineers imagined they were looking well into the future when they laid down as an axiom that the ultimate capacity of a telephone exchange should be estimated at one-tenth of the population of the town and surrounding country in which it was located. But even this optimistic estimate has become too small for some towns, and the telephone man who estimates the possible growth of the telephone business by the number of houses, or rather by the number of families in the city and surrounding country, seems to be nearer the mark. . . . Looked at from almost any standpoint, it is not saying too much to remark that the telephone engineers of the near future will have to do some very hard thinking."

Mr. Guy M. Walker believes that "the real weakness of telephone securities lies in the uncertainty of the total investment necessary to build any given plant. Experience has shown that the public demand for telephone service is growing so rapidly that the existing companies are absolutely unable to satisfy it and a plant originally projected for a given capacity finds the entire switchboard capacity subscribed for before it is ready for operation, and great numbers clamoring for the service, and the original projectors find it necessary to double, triple and even quadruple their originally contemplated investment in order to satisfy the wants of the public for such service. The effort to satisfy the extraordinary demand for telephone service by increasing the plant and investing the necessary capital, even though it be two, three or four times what they originally expected to invest, has often drained the resources of the original projectors. This is exactly the case of the Everett-Moore Syndicate, of Cleveland."

The editor of the ELECTRICAL REVIEW, in writing on this subject, said: "Marvelous as the growth has already been, we are satisfied that it has but just begun. In some small centres, to be sure, nearly all of the possible users have been reached. These are exceptional cases, and in them the movement toward greater numbers will depend on the growth of the population and general business development. In cities and in the country at large, although telephones are being installed by the hundreds of thousands, it will still be many years before all who require telephone service will be supplied. When we consider the vast multitude who have not yet taken advantage of the great economies resulting from the telephone service, and when we consider the rapid increase of the population of the country, it is impossible to predict anything but long-continued prosperity for the telephone industry."

Professor J. C. Kelsey says: "The telephone business has reached gigantic proportions in such a short time that one can hardly realize its vast possibilities. It is only a question of a few years when 5,000-line switchboards in cities of 20,000 people will be common, while a few years back cities of 20,000 inhabitants had exchanges with but 500 to 1,000 subscribers. The growth is not so much a result of a reduction in rates as of the gradual recognition of the utility and, indeed, necessity of the telephone service by the people. In places where high rates have existed the growth has been just as phenomenal as in places enjoying low rates. Large cities will ultimately support many times the equipment of their present exchanges. It is no idle boast when the president of a large telephone company says that Chicago will have 100,000 telephones."

Mr. Arthur V. Abbott states: "From present indications it seems quite certain that cities of 500,000 population and over will soon have at least 40,000 to 50,000 subscribers. Those of 200,000 to 300,000 inhabitants from 20,000 to 30,000 telephones, while towns of 75,000 to 100,000 people should be credited with not less than 10,000 stations. It is difficult and somewhat hazardous to assign a value to the originating traffic on account of the rapidly changing character of the telephone business."

Mr. Wilbur H. Johnston said: "In planning a telephone system for Buffalo we are keeping in mind the growth of this means of communication in Chicago. In that city in 1888 there were about 5,000 telephones in use. In 1893 this number had been increased to 25,000. At the rearrangement of the system in 1900 provision was made for 100,000 telephones, and to-day the company is talking of doubling this latter number."

Less than a year ago Mr. Will Christy wrote: "The growth of our properties has been very large and has taxed our construction department to take care of same, and we are occupying a peculiar position of wondering where the growth will cease and when construction will end."

The Hon. Hugh Doherty, the pioneer independent bulwark in Indiana, told the members at the National Independent meeting, in Cleveland in 1901, that "the greatest mistake in the independent telephone field up to this time has been in the character of the construction and equipment. At the beginning of the movement so many of the appliances of electricity in the telephonic art were covered by patents that the independent manufacturers found themselves handicapped and were compelled to use devices that were crude in their nature and slow in operation. It has been the universal experience that the business has overreached the rosiest estimates of the most optimistic directors; and I doubt whether there is a single independent company in the country three years old that has not been compelled to enlarge its office equipment or rebuild its leads at least once."

The president of the Independent Telephone Association, the Hon. James M. Thomas, of Ohio, in his annual presidential address delivered at Cleveland, in 1900, said: "It will take at least seven hundred million of dollars to install all the telephones that our present population requires. When we think of this possibility, the broad expanse of territory, our great population, and the almost incomprehensible number of dollars that it will take to supply the demands to be created, we wonder how it is possible that men should take a narrow view of the subject and allow themselves to waste time and money in warfare over territorial division. There is ample territory for all, and certainly a place for every dollar there is to invest. What we need more than anything else at this time is good, clear business judgment that will devote itself to this great work."

Here is an eminent and well informed

authority in the independent telephone field taking the broad view that "it will take at least seven hundred millions of dollars to install all the telephones that our present population requires."

Under the most advantageous circumstances it would require at least ten years of time to complete an undertaking of such magnitude. And, should the present rate of increase in population and the growth of prosperity and intelligence continue here in our country, entailing a corresponding increase in the number of telephone users, is it at all improbable that before the first decade in the present century closes, an investment exceeding one billion of dollars will be found necessary to supply telephone service to all the people willing to pay equitable rates for that which is comprehensive and satisfactory?

The telephone journals contain many accounts of the transformation of independent exchanges from grounded iron circuits or from common return iron and copper circuits, to complete copper metallic circuits, express or transfer or multiple switchboards and improved equipment, all of which were rendered necessary by the marvelous growth and the number of subscribers.

Mr. H. M. Fisk has said: "Many exchanges have found it impossible to supply additional patrons with service for the simple reason that it was impossible to get more wires into the exchange. Such exchanges resemble the man who started to build a mansion by erecting the kitchen and then adding rooms as his means would permit." And an independent company in Pennsylvania has made this statement: "The company's first installation consisted of 175 lines, which was at once increased to 300. In a short time the exchange outgrew its quarters and it was moved to more commodious ones, where 500 lines were installed. This number was soon increased to 700 lines and three subexchanges were installed. The 700-line equipment consisted of seven 100-drop boards with common return. And a 1,500-line equipment has been in service for some months. The crudity of wiring and construction in the earlier days of independent telephony is strikingly contrasted with the simplicity, orderliness and finish of the present day."

Mr. J. G. Ihmsen has written: "It is most gratifying to all manufacturers to note the improvement being made in the quality of independent construction. A costly but impressive lesson has been learned by those who several years ago built their plants or toll lines with materials of indifferent quality, and others entering the field are undoubtedly profiting by the past experience of the ones that are of necessity compelled to rebuild their exchanges. A very common error in the past has been made in underestimating the ultimate requirements of the contemplated exchanges which were accordingly built with short poles, insufficient cable capacity, limited terminal facilities, curtailed exchange accommodations, and last, but not least, in many instances capital inadequate to provide for the necessary additions to accommodate the increased demand for service."

Mr. L. W. Burch wrote: "I do not know of an exchange to-day the foundation for which was made too large or even large enough. The older ones in the business are gradually getting to understand the fact that the telephone business does not consist of a bean-pole, a piece of barbed wire and an oyster can. It is something entirely different. They are realizing now what they should have realized when they first formed their company to go into business. There is not nor never will be anything enter into the telephone business to deter or stunt its growth so much as the so-called cheap construction."

Mr. A. E. Dobbs says: "Aside from the buying of instruments and switchboard equipments, however, it is easy to make very costly mistakes in construction; mistakes that will cost a great deal to rectify when the exchange grows larger, as it will if properly managed. In some exchanges the rebuilding has cost a great deal more than a first-class plant could have been put in for in the first place. Rebuilding does not pay dividends while it is going on."

This demand for replacement, rebuilding and renovating is nothing new, but has existed for years. For M. De La Touanne told the delegates to the International Electrical Conference, held in Paris, in August, 1889, that "the very rapidity with which this industry has developed carries in itself a serious inconvenience. Scarcely is one system adopted than another more ingenious and more practical is brought out, and we have seen in a great city a company, jealous of its good name and anxious to make its service of the best, abandon a system whose establishment was barely terminated, and cast away installations just completed, to begin again the organization at its base and create anew, in all details, a system in harmony with recent progress."

And twelve years later M. De La Touanne, in presenting a series of curves corresponding to the collected data showing the increase in the number of Bell telephone stations for eighteen years, said: "The general appearance of these curves would make one think that there is some simple law from which the growth of the business in the next one or two years can be rather exactly foreseen. That would be a hasty and incorrect conclusion, for the rate of increase for any of the curves seems to grow from year to year, and it is absurd to suppose that such a law can stand indefinitely. It is evident that at some time the rate of increase must stop growing, become uniform and perhaps decrease; for instance, it is obvious that, above a certain value, the number of subscribers could not increase faster than the population. . . . The yearly percentage of increase for the number of stations . . . show that it was necessary to ascertain if the annual rate of increase were responsive to some law, and that, unfortunately, there is no such law. If the data were those of a special exchange it would be interesting, and it would be profitable to examine if there is some relation between the variations in the rate of increase and the variations in the system of tariff, but that is not the case."

That is the practical side of this question of depreciation following excessive growth. The Bell has suffered, and probably always will have to suffer ever-increasing loss from the same causes. Here is one illustration of how great a loss a telephone company may have to charge off by reason of unexpected and excessive growth. A writer in the *Electrical World* states that "on Saturday night, November 2, the New York Telephone Company calmly and deliberately dumped $400,000 worth of telephone apparatus into the scrap heap and started at Cortlandt street a new exchange in place of the old one, in order to increase the efficiency of its service. The salvage from the old board and the old subscribers' equipment is far too small to be mentioned. The equipment is still in sound working order, and is replaced simply because a better system has been invented. At the time the old switchboard was built it was the largest metallic circuit multiple switchboard in the world, and was equipped for 6,000 lines."

That such radical and costly changes are by no means new in the telephone field is evidenced by the following extract from the report of a committee in 1888 to the Legislature of the State of New York: "As one of the illustrations of the expense

of constructing a telephonic exchange, which is little understood by the public, we discovered that the Metropolitan Telephone Company, at the time of the passage of the law requiring its wires to be placed underground had just completed a switchboard designed to accommodate 6,000 subscribers. Its cost was $180,000. It was discovered that the underground system requiring a metallic circuit involved a change in the method of its construction. It was, therefore, changed when nearly completed at an added cost of about $80,000, and now, when it is again nearly completed, so rapid has been the strides in electrical inventions it is merely an antiquated piece of machinery." And the committee went on to state that "the evidence shows the substitution of an underground for an aerial system will entail a loss of three-fifths of the entire net earnings of the company since its organization." The Metropolitan was the predecessor of the New York Telephone Company which "deliberately dumped $400,000 worth of telephone apparatus into the scrap heap."

Referring back to the new installation that took the place of the one junked on November 2, 1901, Mr. J. J. Carty explained to the members of the New York Electrical Society that "in making the comparison between the old system and the new, I wish to call your attention to other conditions which, when rightly viewed, will establish the fact that, after all, there has been a successful movement in the direction of simplicity. It should be borne in mind that in the old system there was required at each subscriber's station two cells of Fuller battery which would, in an installation of the present magnitude, amount to 18,000 cells. All of these Fuller cells have been replaced by eleven cells of storage battery of the chloride type, located at the central office, and occupying only 110 square feet. If the 18,000 cells of Fuller battery were assembled at the central office and arranged on racks in the most economical way, they would occupy a very large space. In the old system, a small alternating-current generator was required at each station. If these generators and batteries were massed at the central office, they would together occupy a space almost equal to that occupied by the entire common battery switchboard itself. The total weight of the present storage cells is only about 11,000 pounds, and that of the local batteries would amount to over 216,000 pounds.

"During the last ten years many improvements have been made in underground telephone cables, but the main ideas of their original construction have been adhered to. Dry cables have taken the place of filled cables, paper has entirely displaced cotton, and the improvement has been in the direction of placing a larger number of pairs of wires in a given lead sheath. Cables of 200 pairs are now the rule, where formerly only fifty pairs were used."

And at another public meeting Mr. Carty said: "Prior to 1899 we had many forms of magneto bells, none of which was entirely satisfactory, and one crop of bells followed another into the junk pile. Then the bridging bell supplanted almost every other bell. Four years ago even these bells—30,000 to 40,000 of them here in New York—were discarded in favor of an improved central battery system. Then the solid-back form of transmitter followed the Blake. But even this transmitter, which has become looked upon as standard, has been modified within the last four years and 50,000 of the older type discarded in New York."

The executive committee of the Milwaukee Telephone Users' Association, in estimating the yearly depreciation in a telephone plant, previously referred to, state that "in making this estimate (nearly ten per cent) it is only fair to state further that no allowance is made upon one account which must eventually cost the telephone company considerable money, and that arises from the fact that the telephone business is still, in many respects, in an experimental stage. We mean by this that new inventions are constantly being made which render the use of prior apparatus no longer economically possible."

Referring to a new switchboard just installed in the main exchange in Kansas City, the *Star* of July 21 says: "Not until next Saturday night will the change from the old switchboard to the new be made at telephone headquarters. When this change is made the old switchboard and the mechanism about it, installed seven years ago at a cost of $70,000, will be fit only for the junk pile. The new board is all in readiness, and the change will take only a moment."

The sworn testimony of a Bell official, given in 1900, shows that "between 1884 and 1894 we have had to put in three entire new switchboards (in this exchange). No. 1 was put in in the winter and spring of 1884. No. 2 was put in during September, 1899. No. 1 was completely worn out; it was the first board built of that style, and it was not built as well as subsequent boards. No. 2 was a multiple board and lasted from 1887 to 1894, barring the multiple jacks, which were often worn out. These boards were not made use of elsewhere, but went to junk. No. 3 was installed in 1894."

Arthur V. Abbott told the members of the American Institute of Electrical Engineers that "it is possible to-day for any one to build a first-class telephone exchange, and with good care, shrewd and expert management, to give service that can not be excelled at the lowest possible price. Such, I say, is possible, but, unfortunately, it is rarely done. On the contrary, a very erroneous idea prevails in the minds of most of the independent companies as to the requirements and limitations of telephony. A large portion of those interested therein seem to have been bitten by a kind of telephonic tarantula until they feel that a telephone exchange is a sort of Golconda. Put it in and it will run itself, rolling in dividends in a way to make the goose which laid the golden egg blush for incapacity. According to their doctrine, all one has to do is to put in a telephone (any kind of a telephone), build a line (any kind of a line), set up a switchboard (any kind of a switchboard), go away and leave it to its own devices, returning once a year to collect the dividends. For instance, the general manager of a 5,000-line independent exchange recently remarked in answer to a question as to cost of maintenance: "Why, we don't have any maintenance, we have a new plant." And another gentleman, president of more than one telephone company, laughed me to scorn when I advised him to allow two dollars per substation per year for maintenance expense, averring that ten cents per year was amply sufficient for the purpose."

Our fourth phase of depreciation is the lessening in value that follows from lack of capital necessary to make extensions absolutely essential, if profitable prestige is to be maintained.

Mr. A. L. Hutchinson, president of the Independent Telephone Association of Wisconsin, in his opening address, told the delegates to the Milwaukee meeting that "there is no business on earth which not only admits of, but actually demands such wide expansion as the telephone business, and no business requiring closer attention to make it a complete success; unlike the conditions of ordinary corporations, the construction work of a telephone plant is never completed; its capital account can never be closed. No matter how successful a company may have been, if it is unable to raise funds to supply the increasing demands for tele-

phones, it soon finds itself in financial straits."

The facts are that once a company begins to invest in an operating telephone plant, there is no end to the demands for further investments, and these further investments must be made if the plant is to be kept among the "going concerns." When building a block of houses, the total cost may be far in excess of the original estimate. But once all the buildings are completed and the grounds sodded or sown and both are turned over by architect and contractor and landscape gardener, all further investment ends save in some minute details. Now, it is not so in the telephone field. The more the company invests and branches out the more imperative becomes the demand for further extensions, for additional facilities, for a more comprehensive or an improved and up-to-date service. And then comes home to the directors that now well-known truth that the more extensive the system, the higher the relative cost of operation and maintenance grows per unit. And not only must a company extend its initial exchange service, but often it must build exchanges in contiguous towns and connect same by serviceable toll lines, till it has expended far more in out-of-town construction than it originally planned to expend in the city.

Mr. George N. Bandy, ex-president of the Independent association, told the delegates to the Iowa convention that: "Sentiment is no longer the prominent factor that it once was in the independent field, and it is becoming more and more apparent that the company giving the best service and the most courteous treatment will secure the business. The discriminating public in the beginning has favored the home company on account of its origin and the conditions under which it was brought into existence. This protection has extended over a number of years, but the time has now arrived when the independent company, even though it be owned locally, must demonstrate its ability to furnish as good service as its competitor, or better, or else 'go away back and sit down.'"

Mr. R. F. Johnson has stated that "nearly every independent telephone company in accepting a franchise from the municipality named a rate based upon a prospective number of subscribers, and none of them realized at that time that the number of subscribers upon which the rate was based would soon be doubled and in some case treble the figures taken in their calculations. But events have proven that such was the case, and telephone knowledge proves that either an independent telephone company should limit its subscribers to such a number as it can properly give service to and make a little money, or it should notify the municipality and the public that owing to the unexpected increase in numbers that it will have to have more money per telephone," and he concludes with this very pertinent question: "Is there an independent telephone company in the country which can not better afford to limit its number of subscribers to those to whom it can give first-class service at a rental which means a reasonable profit and to those who can afford a telephone, rather than to seek to multiply its number of subscribers at the same rates with poor service and at little or no profit."

The editor of the *Telephone Magazine*, in commenting on the issuance of certain bonds, said: "All of which means that a good telephone property can be bonded for its cost and pay dividends on stock. But the bonded indebtedness of telephone exchanges, which represents a large profit on construction, will swamp the ordinary exchange and render the stock of doubtful value. Investors seeking independent telephone investments should be assured that their holdings are in the exchange and not in the pocket of the promoter. . . . In some cases we could name the local people have been given an opportunity to invest in the capital stock of the company, the bankers, however, retaining a sufficient amount of the capital stock to give them a controlling interest and direction of the affairs of the operating company. On this basis the promoters secure payment for the plant at a handsome profit in cash, which more than represents its value, and the people who are induced to invest in the stock of the company hold certificates which do not represent any tangible property until the bonds have been redeemed. As the bonds are usually held by interests friendly to the promoters the local stockholder has but little more than an evidence of his hope."

Mr. Hoge told the members of the independent association in Ohio, that "great care should be used in financing new projects and sufficient funds should be raised, either by selling stock or floating bonds, to take care of the growth for some time to come. Many failures have resulted from attempting to operate on too small a capital. Concerns which have enjoyed a rapid growth have attempted to provide for large improvements without securing additional capital, relying on their earnings to pay for extensions. For this reason they have been unable to pay dividends, causing their stockholders to become dissatisfied. This has had a tendency to enforce retrenchments, and in some cases the service has suffered." Yet Mr. Hoge evidently forgot Mr. Dill's advice that "the value of capital in the case of an industrial company depends not upon the extent to which that capital represents actual cash put into property, but the extent to which property owned can earn a return on capital outstanding. In other words, earning capacity and not actual cash outlay is the test of capital value." But how is it possible to determine true earning capacity if proper depreciation and maintenance charges are omitted? Touching on this very point Mr. Abbott depicts five "results that are certain to follow," two of which are: First—Many of the present organizations lack experience and strength, located in unpromising fields, will go down with the first monetary stringency, throwing by their ruin considerable disfavor on the financial aspect of telephony. Second—The remaining independent companies will be forced to adjust their rates until such a point is reached as to enable them to become investments of reasonable earning power, and to this end only the most carefully designed, best constructed and shrewdest managed plants can possibly survive.

So the question naturally arises: How will it be possible to give the superior service if the funds necessary to make extensions and introduce improvements are not forthcoming? And lacking the improvements, will there not be a marked lessening in value?

The Cure of Cancer by the X-Ray.

Dr. Dowling Benjamin, of Camden, reports that, so far as could be ascertained from published cases, about twenty undoubted cases had been cured, and four others had remained over two years without relapse. Since the X-ray could pass through six inches of wood and burn the human body without burning the wood, this powerful agent must necessarily influence cancer, even if deeply situated. Dr. Talbot R. Chambers, of Jersey City, states that while his personal experience with this new method has been limited and not favorable, he had recently been informed by Dr. J. E. Stubbert that it was possible to pass the X-ray through a speculum and then bend the ray to focus it on a particular part. This should prove a valuable addition to the technique.—*Medical Record.*

THE CONSTRUCTION OF TELEPHONE EXCHANGES—XXXVII.

BY A. E. DOBBS.

In the reading of all line resistances temperature must not be forgotten. In the examples given in Figs. 149-154, the resistance of the line is assumed to be 8.5 ohms per mile, which is correct for No. 12 wire at a temperature of 75 degrees Fahrenheit only. All wires change their resistance under the influence of heat and cold and should the temperature in the above case fall to the freezing point, we should have a decrease of 0.097 for each ohm of line resistance, or a total for the 445 ohms of 43.165 ohms, leaving the resistance of the line 401.8 instead of 445 ohms, which would make a considerable difference in our calculations.

There is another difference that sometimes occurs through the use of different instruments arising from the different standards used. Prior to 1893 the value of the ohm had not been exactly determined and the result is that we have three standards of measurement all based on the centimetre-gramme-second system, but varying in the length of the mercury column on which the standard was based.

The oldest of these is the British Association unit, adopted in 1884, which consists of a column of mercury one millimetre in cross-section and 104.8 centimetres in length, at the temperature of melting ice. This value, however, was found to be incorrect, and a later committee estimated the length of the mercury column to be greater and fixed on a length of 106 centimetres as the proper value until it could be more accurately determined. This is called the "legal ohm." But this was not quite right and a committee of the most eminent electricians in the world at the International Congress of Electricians, held in Chicago in 1893, which had been previously appointed for that purpose, fixed its theoretical and practical value as the resistance of a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of constant cross-section and of a length of 106.3 centimetres. This is called the international ohm and is now recognized by all governments.

Notwithstanding this, we sometimes find galvanometers and voltmeters still marked in so-called "legal ohms" and B. A. units, and though the difference in small measurements is not very great, still it is noticeable in measurements of 100 ohms or over, while in measurements of 1,000 ohms the differences would be

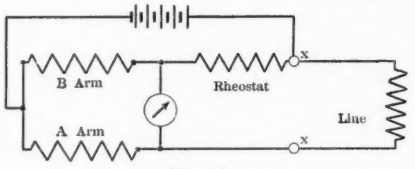


FIG. 156.

great enough to attract attention, being as follows:

International ohms	1,000
Legal ohms	1,002.33
B. A. units ohms	1,013.58

Thus we see that if used in measuring resistances of 10,000 ohms there might be a difference of 136 ohms between a B. A. and an international standard instrument; therefore, the desirability of obtaining from the manufacturer a statement as to the standard he proposes to furnish with his instruments is apparent. Some catalogues, we regret to say, are very vague on this point and the writer not long ago saw an instrument on the market that was marked in B. A. units, and it was not an ancient or second-hand instrument either.

While on this subject of errors it might be well to mention two or three other sources from which slight mistakes arise.

The first of these comes from the difficulty in reading the rather sluggish gal-

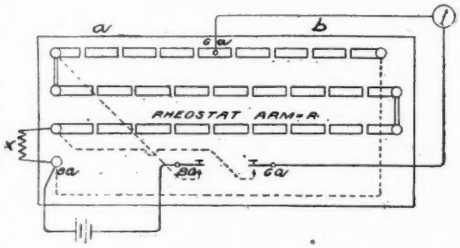


FIG. 157.—SIMPLE FORM OF BRIDGE.

vanometer that usually accompanies a portable test set, for in order to obtain a quick reading, and at the same time reduce the galvanometer to the smallest possible size, the magnets are made quite strong, which makes the pointer slower in action and at the same time brings the needle almost instantly to rest, but decreasing its sensibility in like proportion.

A high-grade reflecting galvanometer, for example, must be placed in a room or on a table where there is no vibration and requires some seconds to come to rest. It is a favorite in laboratory work where careful testing is required, but it would not be convenient for ordinary line testing where there might be a large number of wires to test out in a hurry. When, however, the resistance plugged in our sluggish galvanometer is very nearly right, the movement of the needle is so slight that the man reading it may not observe it closely and thus make a mistake of several ohms. Another mistake may be made in reading the deflection through the glass cover which makes a reading glass very convenient.

Again a possible error lies in keeping the keys pressed down too long, thus causing the temperature of the coils to rise and altering their resistance. The keys should not be pressed down for more than two or three seconds at one time. Two seconds is sufficient for almost any reading.

Another error may arise from the adjustment or lack of accuracy of the coils themselves.

While the accuracy of a high-grade resistance box may be within one-fiftieth of one per cent, yet the ordinary bridge coils are not guaranteed closer than about one-fifth of one per cent. If in the rheostat arm of the bridge only this one-fifth per cent would mean 1 ohm in 500 or 2 ohms in 1,000, which in the measurements of line resistance is not of very great importance, as they can not be figured down to single ohms anyhow, except, perhaps, in the testing for faults in cables where one error will balance another. According to manufacturers, the probable error from this cause equals the square root of the sum of the squares of the individual errors; but more of this later.

While there are many methods of finding an unknown resistance in an external circuit, the voltmeter method given in a previous chapter being one, yet, on account of its directness, comparative simplicity and freedom from troublesome calculations, a portable Wheatstone bridge, in connection with a good D'Arsonval galvanometer, still remains the most popular and serviceable for all kinds of ordinary work. The objection to it, from a manager's point of view, is its comparatively high first cost, and the fact that he has to have some one around who knows how to handle it, as it is not read directly in ohms, but is complicated somewhat by the use of ratio or balance arms and a multiplicity of plugs—always a nuisance—which requires to be translated before the final result is known. As the ratio arms, however, run in multiples of 10, 100 or 1,000, the calculation is not difficult enough to be worth considering. But while there seems to be considerable

room for improvement in the general make-up, yet it is the best we have at present, although with its increasing use we look for still further improvement and perhaps a reduction in price.

There would be a lively demand for a standard instrument at a low price, and when we speak of a lower price for these instruments we can refer to the bridge arms only, for it seems possible that by the use of graphite or carbon resistances the use of such expensive alloys as platinoid or manganin now used in winding the resistance coils might be dispensed with; this, however, seems impractical at the present time.

A standard galvanometer or voltmeter is as carefully made as a watch, without the demand that makes watch-making on a large scale by machinery a profitable undertaking. All bearings are set in jewels; magnets, as well as the wire used in winding the coils, must be carefully aged and coils balanced with the greatest care in comparison with the best standards obtainable. When we consider that the working parts must be worked down to a perfect fit, where plugs are required, and all exposed parts mounted on polished hard rubber, the price does not seem so excessive. The writer has known instances of mechanics trying to save expense by making their own bridge sets, but while they saved some money not one ever tried it more than once. Probably no invention has benefited electrical men more than the invention of Wheatstone's bridge which allows readings to be taken far beyond the practical value of any ordinary rheostat and reduces calculations to their simplest possible form. By its use a rheostat containing coils wound to 11,000 can be made to read 11,000,000 ohms, and all this by the use of no multiplying factor other than 10, 100 or 1,000 which can generally be performed without the necessity of putting down a single figure on paper.

The principle upon which the portable bridge is built is that when a circuit is given two paths the current flow will be in inverse proportion to their respective resistances; also, that it will flow through both paths no matter how great the difference between them might be.

Theoretically, there is no such a thing as short-circuiting one conductor by another. There might be 10,000,000 ohms' resistance in one path and one ohm in the other, but the long path would still take 0.000001 part of the current flowing.

Fig. 156 is a sketch diagram of the ordinary bridge circuit which we will now proceed to analyze. From the battery a connection leads to the right and divides between A and B arms. At the ends of these arms a galvanometer is bridged between them. Beyond the galvanometer is the rheostat arm to the outside end of which the battery is connected through a key which, for the sake of simplicity, is omitted. To the post X, one terminal of the line or other resistance to be measured is also connected, while the other X terminal is connected to the other side of the line and also connects directly to the B arm of the bridge. The resistance of the A and B arms can be changed to 10, 100 or 1,000 ohms as may be desired, either by means of plugs or a sliding switch. The rheostat arm can be changed by means of plugs or switches to any resistance from 1 to 11,111 ohms to balance the line, the resistance of which remains

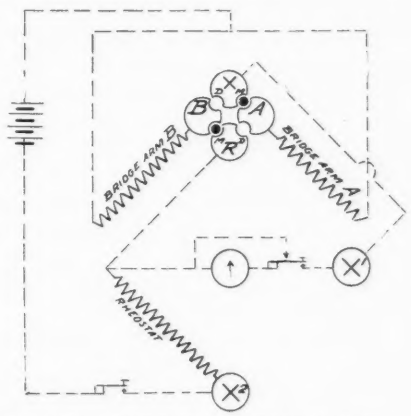


FIG. 158 —BRIDGE WITH REVERSING PLUG.

to be found. Now for the result: The battery current has two paths; one through the A arm and the rheostat, the other through the B arm and the line. Should there be a perfect balance in these two branches the amount of current passing over them would be equal, and though the galvanometer forms a bridge, yet the current in passing through it would do so in opposite directions with the result they would meet at the centre and neutralize each other so that there would be a condition of no current flowing and the needle would stand still at the zero point. This balancing of the galvanometer between the two arms of the bridge is known as the zero-deflection method as distinguished from the direct-deflection method which will be described later.

It makes very little difference how this balance is obtained; the A and B arms might contain a resistance of 100 ohms each and the rheostat and line 10,000 ohms each, but the result would be the same, for the pointer would indicate zero. As the rheostat, as already stated, does not contain over 11,111 ohms, this would limit the range of the test set to that amount, but for the fact that we can unbalance the A and B arms to strike a balance between the high resistance and the rheostat.

Let us presume to have a resistance of ten ohms in the B arm and 1,000 ohms in the A arm, a ratio of 100 to 1, and at the same time the rheostat and line have a resistance of 1,000 ohms each; it is very plain that there would be 100 times as much current flowing through the A side of the circuit as through the B side, and that the difference between the two sides would cross the galvanometer and draw the pointer very forcibly to one side or the other. If, however, we should suppose the line resistance to be 100 times greater than that of the rheostat then we would again obtain a balance which, in the above case, would be 100,000 ohms.

Example 1: With a ratio of 100 ohms in each bridge arm we proceed to measure a line or other resistance and get a balance at 1,365 ohms in the rheostat. What is our unknown resistance?

Answer: As the ratio arms are balanced the resistance, therefore, must balance that of the rheostat, which is 1,365 ohms.

Example 2: With the B arm at 1,000 and the A arm at 10, a balance is obtained at seventy-five ohms in the rheostat. What is the resistance of the line?

Answer: As the ratio is 100 to 1, the resistance of the line must be 100 times greater than that of the rheostat = 75 × 100 = 7,500 ohms.

From the above examples it will be seen that by making the B arm greater than the A arm we obtain a multiplying factor for the rheostat of 10, 100 or 1,000 as the case may be.

By altering the ratio of the bridge arms we can also obtain a dividing factor, a very great convenience in the measurement of small resistances, as, for example, the resistance of a line joint which should measure only a few thousandths of an ohm.

This is done by giving the B arm the low and the A arm the high resistance when our rheostat reading becomes divided by 10, 100 or 1,000 instead of multiplied as in the two previous examples.

Example 3: With the B arm 1 and the A arm 1,000, a reading of 798 ohms in the rheostat is necessary to reach a balance. What is the resistance of the circuit?

Answer: As the ratio is 1,000 to 1, divide the reading by 1,000 = 798 ÷ 1,000 = 0.798 of an ohm.

Fig. 157 is an illustration of a simple

form of bridge, but it differs from Fig. 156 in that the battery is connected to the outer end of the A, B arms instead of to the centre, and the galvanometer to the centre instead of the outer end, but the effect is the same in one case as in the other. The coils are connected in series between the blocks, and resistance cut in by leaving out the plugs.

The battery circuit is always open except when the keys B*a* and G*a* are pressed down. The A arm and the rheostat are connected in series, a fact which is mentioned to call attention to another feature, and that is that the terms A and B are reversed.

In Fig. 158 we have a plan of a bridge by a well-known manufacturer which shows a reversing plug that indicates on its face whether division or multiplication is intended. In this bridge, also, the rheostat is normally connected to the B arm instead of the A arm, as in Fig. 156, so that in working this bridge the plugs given for the ratio arms would be connected as in examples 1, 2 and 3. On the face of the plugs we have A and B which indicate the A and B arms, R which is the rheostat and X which connects with the line post X^1, the outer end of the rheostat connecting with the other line post X^2. We also see two other letters, MM and DD, placed beside the plug holes which indicate division or multiplication as the plugs are shifted. This appears different from Fig. 156, but it is the same.

Formulæ: With A connected to X and B to R, $X = \frac{A}{B} \times R$.

With B connected to X and A to R, $X = \frac{B}{A} \times R$.

Professor Birkeland recently left Christiania for Archangel in order to start from there on July 23 and proceed to Matoschkin Strait, Nova Zembla, to organize and set in working order a similar station and leave it in the hands of four observers before returning to Norway. At Bossekop, where observations will also be made, the observatory is admirably situated on the summit of Haldde Mountain; for at the base a tunnel belonging to a copper mine runs for 250 metres into the mountain, and registering apparatus can be set up in it. Simultaneous observations can thus be made on the electrical currents in the atmosphere and in the earth. The third station will be on Axel Island, Spitsbergen. A fourth station, with two observers, will be at Dyrafjord, Iceland, and researches will be carried on for about a year at all of them.

The American Street Railway Association Convention.

The American Street Railway Association convention, which will be held in the Life Guard Armory, Detroit, Mich., on October 8, 9 and 10, 1902, bids fair to be one of the best which this progressive association has ever held. The assignment of exhibit space is very complete, and a varied and remarkable list of exhibits is already assigned. Owing to the great demand for space it is necessary to reduce the space of applicants more than 100 feet by a reduction of 33 per cent. This allotment is final and can not be revised. The committee reserves to itself the right to cancel application for space not paid for by October 1, 1902. Payment should be made to Mr. T. C. Pennington, treasurer American Street Railway Association, 2020 State street, Chicago, Ill.

Among the exhibitors already assigned spaces are the following:

Adams & Westlake Co., 110 Ontario street, Chicago.

American Machinery Co., Grand Rapids, Mich.

American Steel and Wire Co., Chicago.

Bishop Gutta Percha Co., 420 East Twenty-fifth street, New York.

Brown, Harold P., 120 Liberty street, New York.

Christensen Engineering Co., Milwaukee.

Conant, R. W., 28 William street, Cambridge, Mass.

Consolidated Car Heating Co., Albany, N. Y.

Continuous Rail Joint Co. of America, Newark, N. J.

Crane Co., Chicago.

Creaghead Engineering Co., Cincinnati.

Dearborn Drug and Chemical Works, Rialto Building, Chicago.

Electrical Review, New York.

Electric Storage Battery Co., Philadelphia.

Garton-Daniels Co., Keokuk, Ia.

General Electric Co., Schenectady, N. Y.

Gold Street Car Heating Co., New York.

Gould Storage Battery Co., 25 West Thirty-third street, New York.

Harrington, C. J., 15 Cortlandt street, New York.

Johns (H. W.)-Manville Co., 100 Williams street, New York.

Lorain Steel Co., Lorain, Ohio.

Ludlow Supply Co., Cleveland.

Maltby Lumber Co., Bay City, Mich.

Monarch Fire Appliance Co., 27 Williams street, New York.

Morris Electric Co., 15 Cortlandt street, New York.

National Carbon Co., Cleveland.

New Haven Car Register Co., New Haven, Ct.

Northern Electric Manufacturing Co., Madison, Wis.

Ohio Brass Co., Mansfield, Ohio.

Ridlon, Frank, Co., 200 Summit street, Boston.

Sherwin-Williams Co., Cleveland.

Standard Varnish Works, 29 Broadway, New York.

Stanley Electric Manufacturing Co., Pittsfield, Mass.

Star Brass Works, Kalamazoo, Mich.

Sterling-Meaker Co., Newark, N. J.

United States Steel Co., 145 Oliver street, Boston.

Van Dorn-Elliott Electric Co., Cleveland.

Weber Railway Joint Manufacturing Co., 1645 Old Colony Building, Chicago.

Westinghouse Electric Manufacturing Co., Pittsburg.

Westinghouse Air Brake Co., Pittsburg.

Wharton, William, Jr., & Co., Philadelphia.

Power Lost by Flywheels.

A series of tests recently concluded in the Nurnberg central electricity station shows very clearly that the resistance which a flywheel offers to the air may give rise in some cases to a considerable waste expenditure of energy. The station in question is provided with two tandem compound engines of 450 horse-power, direct-coupled to the dynamos, and working at ninety-five revolutions per minute. In order to equalize the running with the great variations of load which occur, a very heavy flywheel was used with the arms of a channel section. These arms were found to offer a great resistance to the air and to create a powerful draught. It was therefore decided to cover the wheel with sheet iron in order to reduce the resistance and thus gain considerable power. In order to test the amount of energy lost, the dynamo was made to run as a motor and thus drive the engine and flywheel at no load. When the latter had no protecting covering it was found to absorb 13,300 watts, but when the covering was replaced it took only 9,874 watts, thus showing a gain of 3,426 watts, or 5.7 horse-power, this being 1.2 per cent of the power of the engine. Counting the current price per kilowatt-hour and a day's run of seventeen hours, it was calculated that this represented an economy of nearly £56 annually. Another test of a similar nature was made upon a 630-horse-power engine, and showed an economy as high as thirty horse-power, or 4.8 per cent of the engine power, which was gained by properly diminishing the air resistance of the flywheel.—*Electrical Engineer* (London).

Department of Electricity, World's Fair, St. Louis, 1904.

Both as regards area and funds this exposition is more advantageously situated than has been any previous exposition. Over twelve hundred acres have already been included in the exposition tract, upon which upward of $50,000,000 will be spent. Of this amount $17,000,000 is now available.

The provisions that have been made for the exploitation of the electrical industries will more than meet the expectations of those interested. The Palace of Electricity, with over 350,000 square feet of space enclosed within its limits, gives room for a most varied expression of what science and engineering have accomplished in discoveries and inventions in electricity.

All exhibits of electrical apparatus will be installed in the Palace of Electricity, excepting such apparatus and appliances as may be offered for such special service of the exposition as will not admit of its being so placed.

Steam and gas will be supplied in the Palace of Electricity for such direct-connected units as form parts of working exhibits, and in the event that the capacity of such generators is in excess of the requirements of the working exhibit of which they form a part it is possible that arrangements advantageous to the exhibitor can be made for the utilization of all or a part of the surplus capacity.

Electrical appliances and apparatus intended for exhibition, but offered and accepted for special service, may be installed wherever such service is required without forfeiture of their rights as competitive exhibits, provided a correct entry is made through the department of electricity, and provided that such outside location has been approved by the director of exhibits.

Ample facilities will be furnished in the Palace of Electricity for moving pieces of machinery not weighing in excess of twelve tons. Any article to be installed which weighs more than twelve tons will have to be moved by special means, and will be subject to an extra charge covering the actual additional cost. Tracks will be provided so that freight can be hauled into the building.

A ruling has been made by the Treasury Department of the United States Government providing for the free entry of all goods intended solely for exhibition. Goods upon entry will be bonded and be relieved of bond upon return at the close of the exposition. In case of sale the duty will be collected. A more complete statement of this ruling has been prepared for foreigners.

The exposition has been most liberal in providing space free of cost, and its officers must therefore, and for obvious reasons, assume arbitrary power in the acceptance of exhibits and the allotment of space. This power will be invariably applied for securing the best general results, as well as in the direction of aiding the greatest possible number of exhibitors to make the most of the opportunity afforded by so great an exposition.

The following official classification has been adopted:

Machines for Generating and Using Electricity—Apparatus for generating electricity. Dynamos producing direct, simple, alternating or multiphase currents. Motors for direct or alternating currents. Modification of currents. Motor-generators. Transformers. Application to transportation. Electric locomotives, electric railway motors. Methods of control of cars and trains. Application to mechanical purposes. Elevators, winches, cranes, capstans, transfer tables, traveling cranes, printing-presses and machine tools. Appliances and methods for the distribution of electric energy; conduits, cables, wires, switches, insulators, lightning arresters, circuit-breakers, complete switchboard.

Electrochemistry—Primary batteries. Accumulators. Electrolytic appliances and processes. Reduction of ores, electroplating, electrotyping. Electrothermic appliances and processes. Production and refining of metals or alloys. Application to industrial chemistry; bleaching, disinfection of sewerage water, manufacture of soda, chlorine, chlorate of potash, etc.

Electric Lighting—Use of continuous or alternating currents. Arc lamps, regulators, carbons for lamps, incandescent lamps, other forms of lamps. Complete installations. Factories, dwelling-houses, public buildings and central stations. Application to lighthouses, navigation, military service and public works. Photometry. Apparatus for determining the intensity, the distribution and illuminating power of light. Electric appliances. Apparatus for safety and regulation. Conduits, junction boxes, switches, cabinets, cutouts, fixtures, chandeliers, etc.

Telegraphy and Telephony—Telegraph instruments, transmitters and receivers, recording apparatus, multiplex apparatus, synchronous apparatus, wireless apparatus. Transmission of speech. Appliances and methods. Instruments, switchboards and complete exchanges. Telegraph and telephone wires and cables. Overhead, subterranean and marine; construction materials and appliances.

Various Applications of Electricity—Scientific apparatus. Laboratory standards. Indicators and recording apparatus for natural phenomena. Electricity as applied in therapeutics, surgery and dentistry. Electric signaling. Application of electricity to railways, mines, public works and buildings. Clocks, annunciators, chronographs, alarms. Methods of measurement. Instruments, indicating, recording and integrating. Apparatus for heating by electricity. Cooking apparatus. High temperature electric ovens. Electric welding. Progress and development in electrical sciences and invention. Historical and statistical exhibits. Instruments, machines, models, drawings and publications.

James Swinburne.

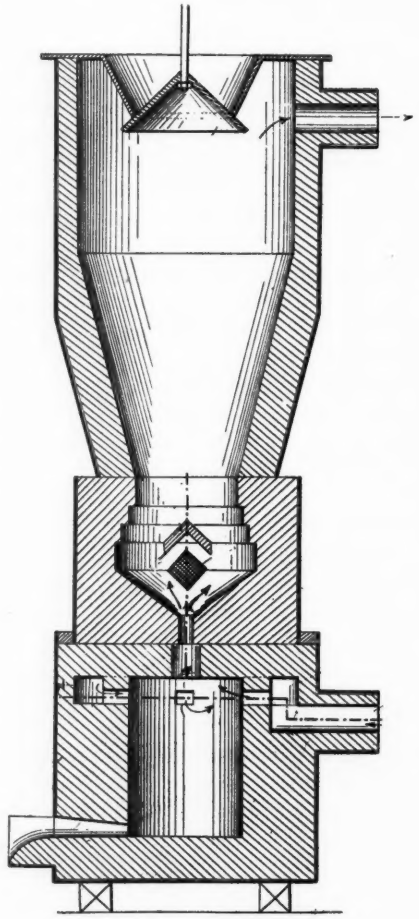
An interesting sketch of the early career of Mr. James Swinburne, newly elected president of the English Institution of Electrical Engineers, is given in the *Electrical Review* (London), for August 1. His early practical training was in a locomotive and marine engine works on the Tyne. In 1881-82 he was engineer for a gasworks at South Shields, just at the time the incandescent lamp was being introduced commercially. In 1883 he was experimenting with accumulators. In 1884 he was making an incandescent lamp of his own. From 1885 to 1889 he was engaged with Mr. Crompton in developing the dynamo. For several years after this Mr. Swinburne was manufacturing transformers and electrical instruments and acting as electrical editor for a technical journal and still able to find time to lecture at technical institutions and read a number of original papers. Mr. Swinburne has a keen sense of humor of which he has made very effective use.

Sault Ste. Marie Water-Power Canal Finished.

Work on the large water-power canal of the Lake Superior Power Company, at Sault Ste. Marie, Mich., has practically been completed. It is expected that water from Lake Superior will soon be turned into it. The canal is two and one-third miles long and has an average width of 224 feet. The power-house is a massive building containing 320 turbines of the McCormick type, equipped with Sturgess water-wheel governors, set in eighty penstocks in groups of four each. Each group of turbines is to operate a Westinghouse generator, and it is expected that a total of 40,000 horse-power will be developed. The power will be used by various manufacturing plants now being built or projected and also to light the city streets and to operate its street cars.

Electrical Patents

A Chilean, Dr. Ramon C. Contardo, who is at present a resident of Sevres, France, has taken out a patent in this country on a new process he has devised for the reduction of metals by means of electrically heated furnaces. A distinguishing characteristic of this invention is that Dr. Contardo transforms electrical energy into heat by means of the voltaic arc, the voltaic hearth being isolated from and out of physical contact with the material being treated, whereby the heat developed is utilized by radiation and convection and not by conduction, as heretofore. As a result of this method of applying the heat he is enabled to combine with the iron the exact quantity of carbon required for the production of cast iron or steel by introducing a quantity of hydrocarbon in the form of gas or vapor with the current of reducing-gas supplied to the furnace. In carrying out the invention the iron ore or the ore of any other metal that can be reduced by hydrogen or carbonic oxide—for the process is a general one—is introduced in lumps of a suitable size into an electrical blast furnace without any solid fuel, but with a suitable flux or solvent of an appropriate nature. Through the bottom of the apparatus, below the electrodes and above the crucible, a current of hydrogen or of carbon oxide is introduced in a dry state, such gas being obtained from any suitable generator. This current of gas has a double function: First—it reduces the ore raised by the action of the voltaic arc in the furnace to a high temperature, and, second, as it passes over the electrodes it carries away a great amount of heat, which it distributes in a uniformly decreasing manner in the column or pile of ore, which latter thus stores and utilizes the heat. The whole heat in the interior of the furnace is thus utilized in its entirety if the pile or column of ore has the required volume. In the particular case where cast iron or steel is to be produced it is necessary that carbon combine with the iron. This may be attained by introducing into the reducing gas current an easily proportionable quantity of a hydrocarbon in the form of gas or vapor. When the operation of the furnace has once been regulated, the appearance of the metal and the test samples taken will show whether it is necessary to increase or diminish the proportion of hydrocarbon. A gas or vapor containing carbon in an easily dissociable form may, of course, be employed. In order to obtain a metal having more or less carbon, the iron may also first be melted and subsequently carburized, as in the Siemens-Martin process, by adding a highly carburized alloy obtained by this process or in other ways. The process forming the subject of this invention thus consists in electrically heating and melting the ore by a voltaic arc isolated from the material being treated and in simultaneously reducing it by means of a current of a suitable gas (the air being excluded), and



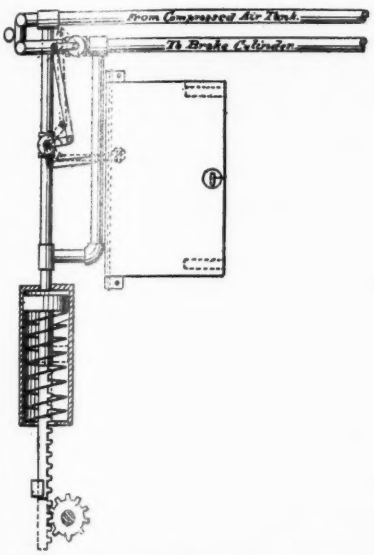
A New Form of Electric Furnace.

where the object in question is to produce cast iron or steel the invention further consists in carburizing agents introduced through the medium of the reducing-gas current.

Mr. Carl T. J. Oppermann, an electrical engineer, residing in London, England, has invented a new composition for use in secondary batteries. The main object is to increase the efficiency and durability of the battery by rendering the active material harder and less liable to disintegration and ensuring more complete and more uniform chemical action so as to avoid buckling of the plates. In order to render the active material harder and more coherent the lead oxide is made into paste with dilute sulphuric acid, to which is added a small proportion of a binding or cementing substance insoluble in sulphuric acid. The substance employed for the purpose is bitumen (preferably Trinidad bitumen) dissolved in a light hydrocarbon, preferably benzine, the solution of bitumen in benzine being diluted with alcohol in order to render it miscible with the dilute sulphuric acid. The proportions found to answer well in practice are as follows: One ounce bitumen is dissolved in ten ounces (one-half pint) of benzine, and this solution is diluted with forty ounces (one quart) of alcohol (methylated spirit), and this diluted solution is added to sufficient dilute sulphuric acid (of about specific gravity 1.170) to make with 100 pounds lead oxide a paste of the required consistency, or the sulphuric acid solution may be omitted, in which case 100 ounces of the dilute bitumen solution would be required for 100 pounds of lead oxide or the alcohol may be omitted from the bitumen solution, in which case 100 ounces of solution of bitumen in benzine alone would be added to 100 pounds lead oxide to form a dry mass to which sufficient dilute sulphuric acid would then be added to form an easily workable paste. After applying the above-described paste to the support it is dried thoroughly at a low temperature to evaporate the solvent of the bitumen, and so cause the latter to cement together the particles of the active material. The cementing action produced by the above-mentioned proportion of bitumen gives such a degree of hardness to the active material as to greatly increase its durability without materially affecting its ampere-hour capacity; but it is to be understood that if the proportion of bitumen be materially increased the hardness and durability will be so much the greater, but the ampere-hour capacity will be proportionately less. The plates are "formed" in the ordinary way. In constructing the battery the grid form of supporting frame is used and the mass of active material contained in the cells of the grid is made of so much less thickness than usual that it undergoes chemical action throughout almost its entire mass, the chemical action being rendered so complete and so uniform that buckling of the plates is almost entirely avoided and the percentage of useful active material is largely increased.

Although the later types of electric car controllers automatically shut off the power as soon as the motorman's hand leaves the controller handle, no means have as yet been adopted for automatic-

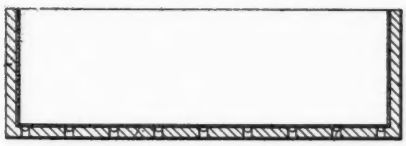
ally applying brakes, should the motorman for any reason be compelled to leave his post. Mr. John H. Robertson has secured a patent upon a device which is expected to supply this need. The apparatus, which is applicable to cars having power brakes, is constructed as follows: Beneath the platform of the car, and in proximity to the lower end of the extended stem of the electric controller, is placed a cylinder. This is fitted with a piston head, the stem of which projecting beyond the cylinder is fitted with a rack. When the piston is moved forward in the cylinder this rack engages with a pinion attached to the bottom of the controller stem and throws the controller round to the off position. The piston head is nor-



A New Automatic Controller Device.

mally held at the inner end of the stroke by a spiral spring contained within the cylinder. From the compressed air tank of the car a pipe is led to the interior of this cylinder. This is fitted with a valve which, when opened, admits air to the cylinder. An auxiliary pipe, also placed beneath the platform and fitted with a valve, leads to the brake cylinder. These two valves are positively connected together so that when either is open the other is closed. An auxiliary platform hinged along its forward edge upon the main platform is normally held at the limit of its upward movement by means of springs. To this auxiliary platform is attached a lever which operates the two valves which have been described. The operation of the apparatus is as follows: The motorman when standing in position upon the car rests his weight on the auxiliary platform, thus retaining it at the limit of its downward movement. In this position the valve in the pipe leading to the brake cylinder is open, enabling the motorman to operate the brakes in the usual way, while the pipe leading to the controller cylinder is closed. As soon as the weight of the motorman is removed from the platform this is thrown up by the springs, automatically admitting air to the controller cylinder and throwing the controller to the off position at the same time closing the valve in the pipe to the brake cylinder and applying the brakes. While the apparatus as described is suitable for air brakes alone it can easily be modified so as to be applicable to any other form of power brakes.

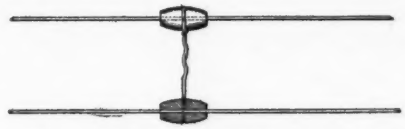
The Electric Storage Battery Company, of Philadelphia, Pa., has purchased a patent granted to Mr. Hugh Lesley, of Philadelphia, on a tank for storage batteries. As is well known, it is usual to place these batteries in lead-lined tanks, and the acid solution or electrolyte frequently overflows or otherwise works



A Drained Tank for Storage Batteries.

its way between the lead lining and the walls. The design of the present invention is to overcome this, and the result is accomplished by providing passageways between the lead lining and the outer walls, which will permit the escape of such electrolyte as finds its way between the two. To this end both the side walls and bottom of the tank are provided with channels leading either to a common exit or to separate discharge exits formed in the bottom. These channels gather the electrolyte and convey it away instead of its being held in the walls as heretofore.

Mr. Mason Grover, of Bidwell, Ohio, has apparently been annoyed by the humming of telephone or telegraph wires located near him, for he has devised means for preventing the nuisance, and evidently thinking so well of it, has obtained a patent on the same. He employs rubber sleeves or blocks, which are split longitudinally, so that they can be placed upon the wires, these blocks having centrally disposed annular grooves. In case there are two or more line wires, the blocks are connected by short pieces of wire having their ends wrapped in the grooves. In case of a single line the wire attached to the body is fastened at its other end to the post. Mr. Grover claims that with the use of his device the objectionable humming noises are entirely prevented.



Device for Preventing Humming of Telephone Wires.

The Electrolysis of Gas Mains.

On Wednesday, June 11, Mr. Swinburne, president of the Institution of Electrical Engineers, delivered a lecture before the Incorporated Gas Institute on the electrolysis of gas and water mains by the stray currents from electrical tramways. He traced the history of the legislation as to tramways and the telephone and gas and water industries. The present position is that tramways may use earthed returns, and are not liable for damages to gas and water companies if their pipes are corroded, provided proper precautions are taken by the tramway undertakers to prevent excessive leakage. The lecturer went on to explain how the stray currents arise, and how they enter and leave the pipes. Electrolytic corrosion only occurs where the electricity leaves the metal and goes into the damp earth. The methods of minimizing leakage are using rails of large cross-section; efficient bonding, or electric welding, or cast-iron jointing; return feedings, return feeders with negative "boosters" or "suckers," and "helpers." The methods of minimizing the effects of stray currents are connecting the pipes by wires to the power-house, or to parts of the rails that are negative to them. One of the chief safeguards is that the tramways must themselves be the chief sufferers by electrolysis, as they have not only their own rails to consider, but they also use lead-covered cables which are very easily attacked, and destruction of these cables would be a very serious matter. The natural earth currents must have effects comparable with those of tramway leakage. Lead and iron service pipes in metallic contact with cast-iron mains are apt to be corroded without any extraneous currents. Finally, the lecturer held that the tramways do damage pipes, but he did not know how far the damage is really serious. Time alone will show whether the pipes will be seriously attacked, but if they are really injured the companies should approach Parliament again later on. Electrolysis is a matter of degree and a matter of time.—*Model Engineer and Amateur Electrician* (London).

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Notes Re Earthing.

In this paper Mr. H. F. Proctor gives the results of a careful study of the problem of grounding one conductor of a distributing system. Where one conductor of a two-wire system is uninsulated throughout its length it is advisable to have this conductor so arranged that it can not be interrupted. Therefore, all fuses and switches should be placed in the insulated side only. If the uninsulated conductor is interrupted at any point the current will flow back to the station by any path left open to it, and there will be risk of electrolysis of gas and water mains. Points for and against risk of interruption with one grounded conductor are made as follows: There is only one-half the length of conductor to be kept insulated; if a ground occurs on the insulated conductor this at once gives trouble; if there be any fault it probably develops at once, while if both conductors are insulated the fault may not be found for some time; there is some saving in first cost when but one wire is insulated. In three-wire systems all the above arguments apply. Where a two-wire system is grounded at one point only it is inadmissible to make a ground on the consumer's premises, for if a ground occurs on the earthed conductor the two grounds will shunt the return current of all installations on the same distributing system, and unless this conductor be protected by fuses a dangerous current may flow. However, when the three-wire system is used it is preferable to incur this risk rather than to burn out the lamps. Hence no fuses should be used in the neutral, but fuses should be placed in the distributing circuits. If a conductor is joined to a neutral conductor, which is not grounded, it must be borne in mind that a ground may occur and the conductor treated accordingly; hence in two-wire installations both conductors should be fused. The chief advantage of the three-wire system is that it allows distribution at low voltage, but the advantage disappears if the neutral be not grounded, since there is danger of a shock from the full voltage—hence the neutral should always be grounded and at as many points as possible. Where a distributing system is grounded at many points it is probably advantageous to use an alternating system to prevent electrolysis, though this might affect non-metallic telephone circuits.—*Electrician* (London), August 1.

Windings for Continuous-Current Dynamos.

In this section of a serial, Mr. J. A. Brunswick discusses the advantages and disadvantages of parallel and series windings. In parallel windings all irregularities in the flux furnished by the different poles, all faults in centering the armature with respect to the field cause unbalanced electromotive forces, and in consequence an unequal division of current between the different armature circuits, and are generally accompanied by heating of the armature. In particularly bad designs this heating is excessive and commutation may be impossible. On the other hand, parallel windings are particularly simple. The choice of the number of conductors per pole is arbitrary and independent of the number of poles. Series-parallel windings, at first sight, seem to be free from these defects as the undulations of the windings cause a distribution of all the circuits under all the poles, and hence the electromotive force in all the circuits and the currents are equal. In multipolar machines with this winding a momentary short-circuit occurs in the sections passing under the brushes, which are thus thrown in tension. When commutation is not regular a differential current will flow through the connections between the brushes. When the contact resistance of one brush varies or if one brush be removed entirely, the currents which would normally pass out here will flow out through the other brushes. The work of the brushes in the commutation of series-parallel windings is very important. Slight variations in the contact resistance, or vibrations of the brush, change the distribution of current among the windings. Any irregularities in the magnetic circuit—faults in the casting, pronounced armature reaction, non-uniform distribution of the field in the neighborhood of the pole-pieces—subject commutation to all the difficulties of the parallel winding only in an aggravated form, as all the sections under the brushes participate in the trouble. These troubles may set up heavy currents, resulting in injury to the commutator and finally making commutation impossible. On the other hand, series-parallel windings have the important advantage of allowing one type of armature to be wound for several voltages. Where the brushes cover more than one segment of the commutator the phenomena are the same as indicated above, but with a slightly more complicated circuit. These difficulties, however, are not insurmountable, as there are machines running to-day with series-parallel windings. The next section of this paper will take up the theory of armature windings as developed by Arnold.—*L'Electricien* (Paris), July 19.

Liquid Fuel for Steamships.

In this paper, which was read by Mr. E. L. Orde, at the summer meeting of the British Institution of Mechanical Engineers, the subject of liquid fuel was taken up in a concise manner and the necessary conditions for proper use of oil as a fuel were discussed. The subject is divided into four heads: The characteristics and calorific value of liquid fuel, the general conditions which must be obtained for its proper combustion in boiler furnaces, the various types of apparatus for burning liquid fuel and the actual results which have been obtained. Under the first head the composition of petroleum is described and the various methods of refining taken up, as these are interesting in connection with the proper burning of the crude material. The two processes of refining are the cracking process and steam distillation. The first of these consists in distilling over the lighter oils at temperatures above those at which they would both boil under normal conditions. This is effected either by allowing the products of distillation to condense and fall back into the still, or by distillation under pressure. There is some question as to the actual calorific value of crude petroleum. The figures given vary from 18.6 B. T. U. for Caucasus oil to 19.2 B. T. U. for Texas oil. Under the head of proper combustion it is stated that the first effects of the furnace heat on the petroleum spray is to liberate hydrocarbon vapors and ignite them on the outer surface of the jet. The ignition raises the

temperature of the whole of the jet and probably dissociates some of the hydrocarbon vapors. As the temperature of the flame rises, the hydrocarbons are probably all dissociated and burn as CO and H. When the conditions are satisfactory the flames are opaque and dazzling white in color for a distance of some six inches from the nozzle of the burner, become semi-transparent and almost violet in color at the middle of their length, and shade into red at the end. If water is present in the oil the combustion is incomplete, the violet color never appears and the end of the flame is dark red and fringed with smoke. In some cases where water is present in comparatively small quantities the end of the flame is white. Three types of burner are described. The mechanical spray, spray burners using a jet of steam or compressed air, and vapor burners. Of mechanical spray burners few have achieved success, as it is difficult to devise an apparatus which is capable of dividing into a fine spray any material so thick and viscous as fuel oil. In the most successful burners of this type the oil is first heated to a temperature of 130 degrees centigrade, and then forced under a pressure of about fifty pounds per square inch through nozzles which impart a vortex motion to the oil, causing it to fly into spray by centrifugal force as soon as it issues from the nozzle. The second type of burner is by far the best known. These burners use steam as a spray medium in general, though there is one type in which air is used. Of vapor burners, pure and simple, there are but few types. In these a small gasifier is heated by means of a fire, and as soon as the oil which it contains is sufficiently heated to give off vapor this is lighted. As soon as this flame is well established the temperature of the furnace is sufficient to maintain the vaporizing process. In all these burners some form of filter should be included and arrangements made for separating water from the oil. The actual results shown are those obtained in steamships only. The consumption of oil per horse-power per hour in pounds is shown to vary from 1.8 to 1.4. In all these vessels triple-expansion engines were used, except in one which had a quadruple-expansion engine. From the figures given it is thought that with a well-designed apparatus it is possible, by good management, to realize in actual practice the full difference in calorific value between liquid and solid fuels at rates of evaporation which are usually obtained in the boilers of mercantile vessels.—*Journal of the British Institution of Mechanical Engineers*, July.

Underground Cable Laying.

In this article Mr. A. T. Stewart considers some of the conduits used in underground cable laying. He divides the systems into four classes—those using bare copper strips, in which the conductors are supported on cylinders and laid in specially constructed conduits; armored or unarmored cables laid direct in the earth; drawn-in systems, using earthenware conduits or cast-iron pipes; solid systems in which the cables are laid in some form of trough which is then filled with a bituminous compound. The diversity of opinion regarding the respective merits of these systems is undoubtedly due to the fact that some systems are suitable in one quarter and entirely the reverse in another. The first-mentioned system has been used extensively for low-tension work, thus saving the expense of covering the copper with insulating material. This construction, however, entails other expenses so that the ultimate saving may be small or nothing at all. This is particularly the case where the conduits must be laid so that any water finding its way into them will be drained away. Further, it is important to carry away any explosive gases which might collect within the conduits. In large distributing systems the continual attention required for this method is very costly. The second system is worthy of notice where first cost is a matter of consideration. This method has been used successfully in many localities, some using armored cables, others simply lead-covered cables. In all cases it is advisable to cover the cable with timber or bricks so as to indicate their presence and modify the chances of damage when excavating. In this system the chief point to be considered is the nature of the soil. Should there be the slightest signs of acids it will be found that sooner or later the outer layer of jute rots off, exposing the armoring which also gets eaten away. This system has the advantage that it is cheap, flexible, easy to lay, and the work may be carried on despite bad weather. The great advantage of the drawing-in system is that new conductors can be drawn in to replace old ones without disturbing the streets. The disadvantages are: The first cost is great; the system is not very flexible since, unless the conduits are laid straight, it is difficult to get the cables pulled through. Faults on conduits are very expensive to repair. In this system also moisture collects in the underground conduits and causes more or less trouble. It is advisable to run wires through these conduits as they are laid, and in this way save the trouble of "rodding." The manholes should be large and roomy. When cast-iron pipes are used lead joints are preferable to cement, though in this case they require careful caulking to prevent any lead finding its way into the inside of the pipe. When more than one cable is to be drawn into one conduit it is advisable to tie them together and draw them in at the same time. Where lead-covered cables terminate with thimbles in the manholes it is not advisable to tape the thimble, for this collects moisture and creeping electrolysis may be set up. Under the last class the Brooks semi-solid system is described. This consists of a welded wrought-iron tube about fifteen inches long. The sections are joined together by an ordinary screw socket, every alternate length being connected by means of a T-coupling. At this point the semi-solid oil is introduced into the pipe. It is important in this system that the cables and tubes be thoroughly dry and free from all moisture. This is accomplished by sending an excessive current through a special wire built in the cable. The advantages of this system are its flexibility, its little liability to be affected by moisture, and it can be laid in large cities where space is restricted. Earthenware troughs have the disadvantage of not being more than eighteen inches or two feet long, thus requiring numerous joints. They are also very liable to damage and not at all convenient for rounding curves. Wood troughs, well creosoted, are most convenient. They can be made in any length and proper bonds easily made at the joints. It is important in these solid systems that the bitumen should get well underneath the cable, and the best way to effect this is to run in a thin layer of compound before the cables are laid. When laying solid systems in wet weather care must be taken that the troughs and cables are kept dry until the compound is run in. The article concludes with the description of the extra high-pressure mains for transmitting three-phase currents as constructed for the Manchester Corporation, England. These cables have three cores, are sheathed with lead and armored with a galvanized steel wire. The lead sheathing is connected to iron clips in the troughs and in this way effectively grounded. Where lead sheathing is used every precaution should be taken to ensure a thorough metallic connection between the sheathing of all cables. The best way of doing this is to securely bond the lead sheathing to the joint boxes.—*Electrical Engineer* (London), August 1.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Magnetic Flotation and Wattmeters.

In the accompanying illustrations are shown the principles upon which are based the wattmeters constructed under the patents granted to William Stanley and Frederick Darlington, and to Otto Titus Blathy, of Budapest, Hungary. These patents cover the use of an alternating-current motor device, operating to integrate in proportion to the electrical energy in circuit, and the use of the magnetic suspension or flotation system which sustains the moving part of the meter in a frictionless manner.

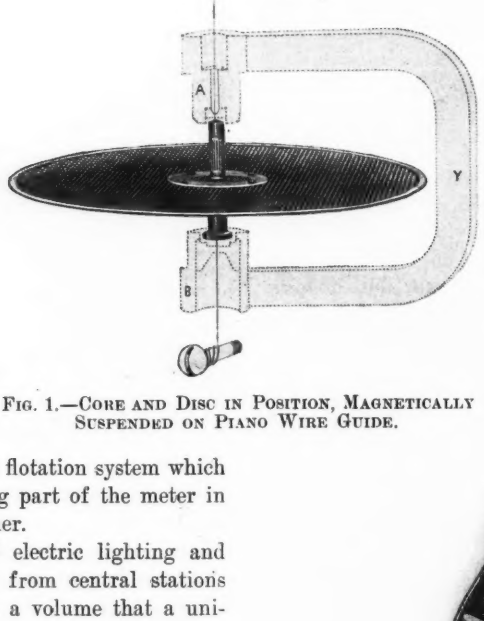


FIG. 1.—CORE AND DISC IN POSITION, MAGNETICALLY SUSPENDED ON PIANO WIRE GUIDE.

The business of electric lighting and power distribution from central stations has grown to such a volume that a uniform unit of measurement is necessary in the conduct of trade between corporations generating and distributing electric current and consumers purchasing the current. Custom and convenience have led to the almost universal adoption of the kilowatt-hour or the thousand-watt-hour as the unit by which electric current is bought and sold. The large business now carried on necessitates an accurate means of measuring by an established electrical unit.

The wattmeters in which this system is employed, the manufacturer claims, have been perfected after long investigation of the causes of trouble arising in the commercial use of meters which have been devised from time to time and give more or less satisfaction under their varying conditions. A satisfactory meter must be a strong mechanical instrument and should be in condition to install when received from the makers without any adjustment further than that necessary to set it up for immediate operation. It should be so constructed as to maintain its original accuracy of registration without recalibrating, cleaning or repairing. It should be sealed in a dust, bug and moisture-proof case in order that the mechanism may not be blocked by rust and dirt.

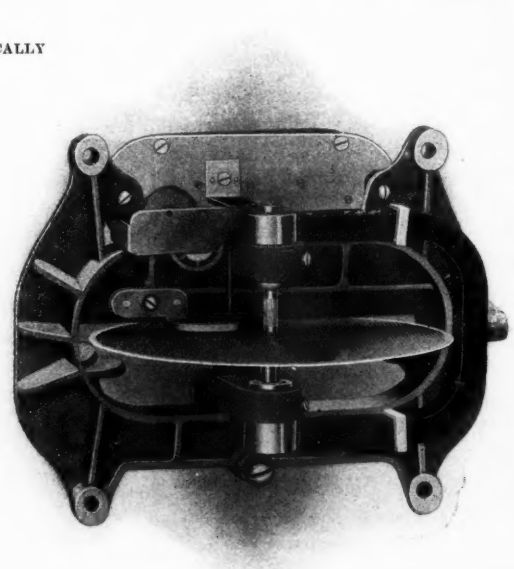


FIG. 2.—ASSEMBLED PARTS OF WATTMETER PRIOR TO BOXING.

The ordinary form of motor meters is made with the moving part of the instrument vertically supported, rotating on an end-bearing. In order to make the friction of meters as small as possible the end-bearing is usually constructed of sapphire, while the end of the vertical staff is a hardened steel cone or ball. The inventors of this system in an endeavor to obviate some difficulties which have been claimed to be inherent in such a method of support have discarded all supporting bearings. There are no jewels nor pivots, and no mechanical apparatus which can be affected by vibration. The rotating disc of the meter is of aluminum rigidly secured to a soft steel core. This core has a small hole drilled longitudinally from end to end through the centre. Small phosphor-bronze rings are accurately located at the ends of the hole. The core and disc are placed in position, as is shown in Fig. 1, and a short piece of piano wire is drawn tightly through the hole in the core and rings and supported in position by two stationary steel plugs placed one above and one below the core. The wire thus drawn becomes a straight, stiff guide between the plugs passing through the vertical axis of the core. The core is thus free to revolve around this guide. The only points of contact between the wire and the core are on the bronze rings.

A magnetic field is created by a permanent magnet "Y," referring to Fig. 1, which magnetizes the stationary steel plugs "A" and "B." The magnetism passes between the plugs through the steel core, and attracts the core and disc supported thereon in an upward direction,

leaving them free from all mechanical support and holding the core in a definite position in space. This method of support is termed "magnetic flotation." The inventor claims that by this form of support, no matter how violently the core and disc, that is, the moving element of the meter, may vibrate in response to the current actuating the meter, such vibration can not injure the instrument, as the vibrated part floats in the air without mechanical support. In this manner it is possible to construct an instrument having a permanent and very small friction coefficient, and a meter which will not wear or change its constant for years.

There are no devices for balancing the meter to give it initial starting torque from the shunt current to improve its accuracy on light loads, this accuracy being secured by eliminating all possible friction. The manufacturer claims to have perfected a meter which is so free from friction that it is ready to respond to the first impulse of current. Starting or light-load adjusting devices sometimes cause trouble with the effect of making them run on a shunt circuit, or, as it is commonly called, "to creep." These instruments have been especially designed with the parts so adjusted and clamped together that humming and other noises due to the current are prevented. Fig. 2 shows the detail of the assembled parts of the wattmeter, prior to their boxing in and sealing in the containing-case. The method of installing is very simple and plainly marked, so that with the positive directions issued with each instrument there should be no trouble in putting them properly and effectively into service.

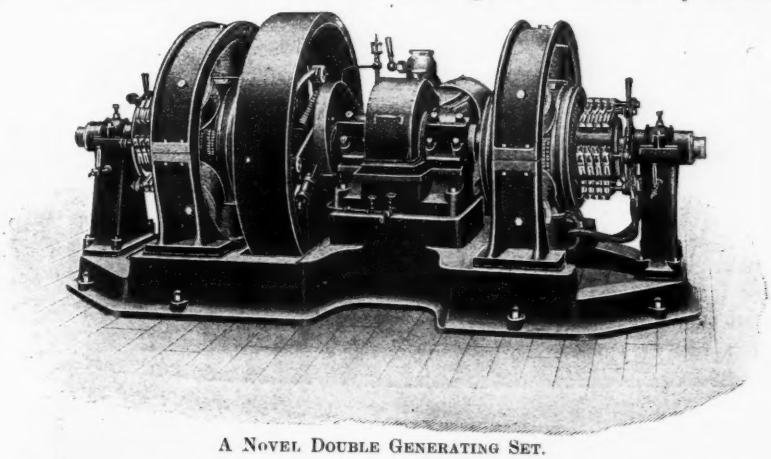
The Stanley Instrument Company, of Great Barrington, Mass., is the manufacturer of this apparatus.

The Industrial Works, of Bay City, Mich., one of the largest manufacturers of railroad wrecking cranes in the world, will shortly install a large amount of additional electrical apparatus for the operation of its shops. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a 150-kilowatt direct-current generator, which will be used to furnish current to eighteen or twenty direct-current motors already in use in the plant; a 200-kilowatt two-phase alternator, and a number of induction motors. The alternating-current apparatus will be used entirely for power distribution. In addition to wrecking cranes, the Industrial Works also manufactures smaller cranes and transfer cables.

A Novel Double Generating Set.

The wide extension in the use of the direct-connected dynamo and engine, with the coincident development and perfecting of the modern high-speed engine, has also witnessed the adaptation of these machines for many special requirements. For instance, in situations where the synchronous rotation of two dynamos is desirable, as in the three-wire system of to-day, the utility of employing a single engine to drive two direct-connected generators will be apparent.

In the accompanying engraving is shown a novel and handsome generating set comprising a centre crank engine and two direct-connected generators. A good idea of the general arrangement, as well as of the generators and governor-wheel, is to be had from the illustration. The two generators and engine are bolted to the same cast-iron subbase, the engine bed being near the centre of the subbase, and the field frames of the dynamos on either side. The two ends of the shaft are carried in outboard bearings which are likewise secured to the subbase. The main shaft carries the two armatures and the large governor-wheel as well.



A Novel Double Generating Set.

The cylinders of this engine are provided with an efficient dead-air insulating space, and a polished sheet-metal covering. The cylinder is of approved design. The piston is remarkably firm and light, combining maximum strength with minimum cylinder wear.

The crank-shaft is a single forging of the best open-hearth steel, to which the counterbalancing discs are so fastened as to reduce the vibrating and shaking forces to a minimum. The connecting rod is of forged steel, and has a cross-head provided with a bronze box, which may be adjusted by means of a wedge and two screws. The crank end is of the locomotive strap type, with a wedge adjustment, and the boxes are lined with the best babbitt metal.

The valve motion is obtained from an eccentric which is controlled by a shaft governor. This governor is especially adapted to the kind of machine under consideration, because of the great regularity of speed required for electric lighting service. It is light and effective and possesses two means of adjustment.

In the design of this engine the essential feature of lubrication has been most carefully considered. The crank disc and connecting rod are enclosed and run in oil, while the wrist-pin bearing is provided with a cup which is supplied with oil from the same source. The outboard bearings are of the standard Buffalo adjustable type, ring oiling and self-aligning. The entire oiling system of this engine is not only efficient, but most economical of lubricant.

The great ease with which all parts of this generating set may be reached for adjustment is a feature of the design. The engine is constructed by the Buffalo Forge Company, of Buffalo, N. Y., and may be arranged for direct-connection to one or two generators of any standard make.

National Association of Stationary Engineers.

The local associations at Chicago of the National Association of Stationary Engineers have made arrangements with the Dearborn Drug and Chemical Works to use their offices and laboratories, situated on the first floor of the Rialto Building, 145 Van Buren street, as headquarters for the delegates and visitors going through Chicago on their way to the convention at Boston, on Saturday and Sunday, August 30 and 31. The offices will be open at six o'clock Sunday morning and remain open until train time. Refreshments will be served. Arrangements have been made to take care of the ladies, and they will be taken to the depot in carriages. Delegates and visitors will take their grips and baggage direct to these headquarters.

Some New Features in the Manufacture of Underground Conduit and Special Clay Products.

In the accompanying illustrations are shown a special form of multiple duct made in two, three, four, six and nine-duct, each three and three-eighths inches square bore, and a third-rail insulator of special design and manufacture. These ducts are made of rock clay, are thoroughly vitreous and impervious to moisture, and are exclusively the only duct made of this style of clay. The Standard Vitrified Conduit Company, of New York city, has established one of the largest factories in the world for the manufacture of these products at South River, N. J., where it has over 150 acres of solid rock clay.

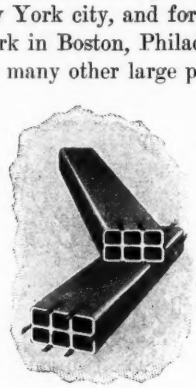
Mr. R. W. Lyle, the president of the company, has had an experience of thirty-five years in the art of clayworking; he has invented a system of keying the joints of multiple duct which is very advantageous for all kinds of construction. Instead of having a single hole or a series of holes through the internal part of the duct and dowels to correspond, slots are cut in the sides of the conduit; into each a steel key having the shape of an elongated keystone is fitted, obviating the necessity of the workmen having to guide the conduit together by any internal alignment; all the alignment being made from the outside, is visible and easily reached. Another form of duct for very rapid construction is one in which a receptacle is punched about two inches in depth in each end of the conduit and a creosoted wooden block, with its edges scalloped so as to meet the rounded face of the conduit, is inserted. As each section of the conduit is laid one of these blocks is inserted in the end of the conduit and the next conduit brought up and very quickly adjusted.

In addition to multiple duct, the company will make single duct in two forms; one with a self-centering joint, and another with plain butt ends.

The insulator shown in the illustration is what is used entirely on the Manhattan Elevated Railway system, in New York city, and by the Westinghouse Manufacturing Company, in London. This is a block of solid vitrified clay about six inches in cross-section and four inches in depth. The block is mounted on a cast-iron stool fitted with four bolt holes. Two segmental clamps rest on the top, the clamps having overlapping flanges and these are drawn tightly to grip the rail by a threaded bolt and nut.

The capacity of the new plant will be 25,000,000 feet per annum. The property, located as it is on the South River, affords every advantage for export shipments or to other water points. Several railroad systems run through the property and also give great facility for convenient shipment.

The conduit for the rapid transit tunnel in New York city, and for the underground work in Boston, Philadelphia and Ohio, with many other large propositions,

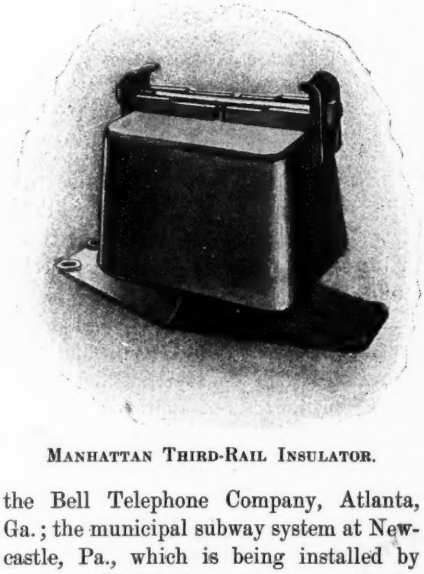


MULTIPLE DUCT MADE IN 2, 3, 4, 6 AND 9 DUCTS.

were all made under the supervision of Mr. Lyle.

The corporation has retained a full corps of skilled mechanics that has been with Mr. Lyle for many years.

Mr. B. S. Barnard, who was sales manager with the old company in the conduit business, is now vice-president and secretary of the Standard Vitrified Conduit Company. He reports that the factory is now in full operation and that he has secured orders in the new conduit system of



MANHATTAN THIRD-RAIL INSULATOR.

the Bell Telephone Company, Atlanta, Ga.; the municipal subway system at Newcastle, Pa., which is being installed by Regan and Mulock, contractors, and also a number of other large propositions which will not require shipment until later in the season.

Magnet wire is copper wire covered with a winding of cotton or silk thread.

The Aeronautic Competition at the Universal Exposition.

Among the rules and regulations governing the aeronautic competition to be held during the Universal Exposition at St. Louis, in 1905, for which the corporation has appropriated the sum of $200,000, one is of great interest as relating to electrically driven airships. The sum of $100,000 is offered as a grand prize to be competed for and awarded under certain rules and conditions. The sum of $50,000 has been appropriated for minor and subsidiary prizes for competitions between airships, balloons, airship motors, kites, etc. The remaining $50,000 is reserved for expenses incident to the competition.

One prize of $3,000 is to be awarded for a successful attempt to drive an airship motor by energy transmitted through space, either in the form of electrical radiation or in some other form of electrical energy, to an actual amount of one-tenth of a horse-power at the point of reception and at a distance of at least 1,000 feet. The test must be made on the exposition grounds by experts satisfactory to the jury.

Electric Storage Batteries.

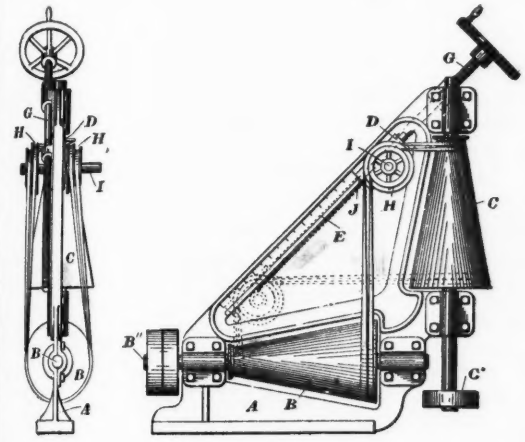
The Exide battery, manufactured by the Electric Storage Battery Company, of Philadelphia, Pa., combines the three necessary features of a commercially successful automobile battery—high capacity, long life and freedom from structural weakness.

The Exide battery is the result of a most careful series of tests made by the Electric Storage Battery Company in the operation of vehicles by the New York Transportation Company; this latter company, after a year or more of continuous service with seventy-five sets of the Exide accumulators, deciding that these batteries provide a sufficient mileage capacity for all classes of service together with a cost of operation, including maintenance, which is reasonable.

Runs of over sixty miles have been frequently made and a conservative estimate of the life of these cells is placed at 6,000 miles. An interesting statement is made by an engineer who has had under his personal observation hundreds of electrical vehicles in daily service to the effect that the Exide battery is "better adapted to its work than some other portions of the equipment, and in point of maintenance cost is a smaller factor in the total expense than are, for instance, the rubber tires on the vehicle it runs."

A Speed-Regulating Device.

A new device along the line on which many inventors are just now approaching the Patent Office—another attempt to solve the problem of greater convenience in speed variation of machinery—is illustrated in the accompanying engravings. Figs. 1 and 2 illustrate a speed-regulator invented by Henry P. White, manager of the New Era Manufacturing Company, of Kalamazoo, Mich. Fig. 1 is an end elevation and Fig. 2 is a side view, the former having the tight and loose pulleys removed. The inventor has set out with the intention to provide a speed-regulator of the cone-pulley type which may be applied in combination with any desired source of power, and to every class of machines which, in practice, is required to run at various speeds. The design also embodies a construction in which the different portions of the contact surface of the belt travel at the same relative speed upon the surface of each cone, thus avoiding the necessity of a compensating constant slip at the contact surface of the belt.



FIGS. 1 AND 2.—END AND SIDE ELEVATIONS.

The natural advantages which the inventor claims for this improved mechanical speed-regulator are, first, its range of variations in speed is practically unlimited, as it may be designed to secure any variation which practice will demand; second, its spring-regulated belt-tension acts as a safety governor in the operation of machinery; third, its automatic speed-indicator makes it possible for the operator to always know at what speed his machine is running; fourth, the easy and practical means it provides for securing any speed intermediate to the two extremes embodied in the design of the machine does not require the operator's hands to come in contact with the belt; fifth, its simplicity of construction which eliminates every undesirable complication.

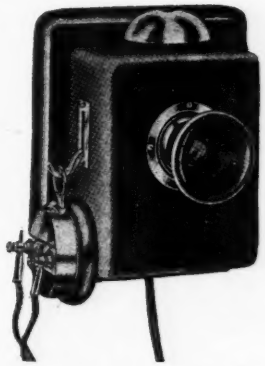
The main frame is indicated by A, and B is the driven cone mounted upon a shaft which carries the tight and loose pulleys, through which power may be applied to the machine. A corresponding cone, C, is mounted upon a shaft located at right angles to the one on which cone B is fastened, the pulley, C', being the medium by which power may be delivered from the machine. A track, E, is fastened to the main frame, or is a part of A, having a sliding frame, D, with a shaft, I, and idlers, H. G is a screw and hand-wheel by means of which the sliding frame may be moved along the track, E.

The dotted lines show the position of the belts when the sliding frame is moved to the opposite end of the track, and the relative places at which the belts are applied will also indicate the proportionate speeds of the cones. Of all frictional devices used to transmit mechanical force the belt and pulleys have proved the most practical and economical; where the contact surfaces of the belts travel at the same relative speed on all the pulleys involved, there is practically no loss from friction except in the journals of the revolving portions of the machine. The devices shown embody this feature of such vital import to success in practice.

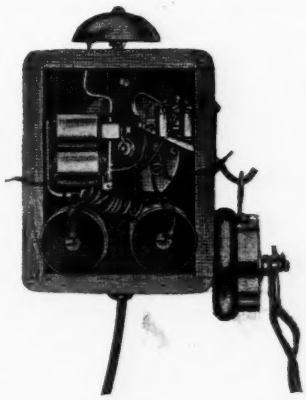
New Telephone Apparatus.

Manufacturers are constantly endeavoring to popularize the application of telephone apparatus for residence and neighborhood intercommunication. The past year has seen many forms of equipment, which have had more or less excellence; the demand for this class of telephone service is rapidly on the increase, and the designing of every piece of efficient apparatus is readily seized, to do away with the older form of tube and annunciator communication.

The accompanying illustrations represent a typical apparatus which has recently been brought out, and the manufacturers claim this to be one of the simplest and most complete telephone equipments on the market. It has been the effort of the makers to embody the highest grade apparatus with a low nominal price, so that the scope of its use might be universal. In introducing this equipment, the endeavor has been made to place on the market an equipment adaptable to the requirements of people in general who are not versed in telephone construction, as well as those of the practical electrician. The instruments are so designed that any one may install them, and the fact that by this simple method one is able to maintain direct communication between house and stable, one room and another, or between neighbors' houses by the use of one wire will, the makers believe, bring the practicability of these telephones within the reach of every one. The outfit consists of two telephones, each telephone being supplied with a double-pole watch-case receiver, single-gong bell, with platinum points on mechanism, two Columbia dry cells, the latest self-contained hook, and a high-grade transmitter. The telephone cases are furnished in ebony and oak, and as the batteries are secured in the box with the instruments it is not necessary to open the telephone when set up. By simply fastening the ends of the wire to the backboard, according to directions, a return call system is complete and ready for use. One hundred feet of wire, screws and staples are also furnished with each installation, and these telephones, it is stated, will talk and ring over a distance of 1,000 feet.



HOUSE TELEPHONE, FRONT VIEW.



HOUSE TELEPHONE, BACKBOARD REMOVED.

The Haines & Noyes Company, 118 West Jackson Boulevard, Chicago, Ill., are the manufacturers of this new equipment, which is known as the "Hanoy Jr.," and the company feel certain that the instrument is of such design and general application that it will meet with a very popular demand.

The National Electric Light Association.

From the present date until January 1 any company can join the association by paying the annual dues. After January 1 an entrance fee of $25 will be charged. The great increase in membership since the Cincinnati meeting bears evidence to the fact that this new rule is appreciated. The following new members have recently been added to the roll:

Akron, Ohio—The Northern Ohio Traction Co.

Bellevue, Pa.—Ohio Valley Electric Co.

Canon City, Col.—The Colorado Electric Power Co.

Danville, Pa. — Standard Electric Light Co.

Dixon, Ill.—Dixon Power and Lighting Co.

Ionia, Mich.—Ionia Electric Co.

Kenosha, Wis. — Kenosha Gas and Electric Co.

Leipsic, Ohio—Leipsic Electric Light, Heat and Power Co.

Lyons, N. Y.—Wayne Co. Electric Co.

Lynchburg, Pa.—Lynchburg Traction and Light Co.

Niagara Falls, N. Y.—Buffalo & Niagara Falls Electric Light and Power Co.

Pottsdam, N. Y.—The Pottsdam Electric Light and Power Co.

Pocatello, Ida.—The American Falls Power, Light and Water Co.

Richfield Springs, N. Y.—Richfield Springs Electric Light and Power Co.

Rhinelander, Wis.—Rhinelander Lighting Co.

Stockton, Cal.—Stockton Gas and Electric Co.

Waynesboro, Pa.—Waynesboro Electric Light and Power Co.

The Manufacture and Use of Briquettes in Germany.

Among the several branches of German industry which deserve the attention of Americans by reason of their economy, their recovery or utilization of some raw material which exists unused in our country, or because they involve the most intelligent application of scientific knowledge to technical processes, may be reckoned the manufacture of briquettes from brown coal, peat and the dust and waste of coal mines. As has been stated in previous reports of this series, briquettes form the principal domestic fuel of Berlin and other cities and districts in Germany; they are used for locomotive and other steam firing, and are employed for heating in various processes of manufacture. For all these uses they have three tangible advantages: They are clean and convenient to handle; they light easily and quickly, and burn with a clear, intense flame; they make practically no smoke, and are, withal, the cheapest form of fuel for most purposes.

Like most other important German industries, writes Consul-General Frank H. Mason, from Berlin, the briquette manufacture is controlled by a syndicate which includes among its members thirty-one firms and companies, or more than nine-tenths of all the producers in this country, and regulates the output and prices for each year. From the official report of the syndicate for 1901, which has recently appeared, it is learned that the total output during last year was 1,566,385 tons, to which is to be added the product of makers outside the syndicate, consumed at works, small retail sales, etc., making a grand total of 1,643,416 tons.

The average selling price in large quantities was 13.33 marks ($3.16) per ton, against 12.27 marks ($2.92) for the year previous, so that, notwithstanding the general relaxation of industrial activity and the diminished pressure upon the coal supply, the ruling price was the highest that had been realized since 1891. Of the 1,566,385 tons sold by the syndicate last year, 749,208 tons were taken by the German railways, 124,380 tons were sold to retailers, 497,136 tons were sold to factories and works of various kinds, and 149,089 tons, or 9.8 per cent, were used by German merchant steamers and the navy or exported to the German colonies or neighboring European countries.

The following tabulated statement shows the production, the sales of the syndicate and the mean price per ton for the past eleven years:

Year.	Production. Tons.	Syndicate. Sales of Tons.	Price per Ton.	
			Marks.	
1891.....	482,495	202,780	12.67	$3.02
1892.....	533,075	516,508	10.47	2.49
1893.....	694,025	645,144	9.08	2.16
1894.....	745,414	719,258	8.82	2.10
1895.....	796,363	780,185	9.07	2.16
1896.....	830,985	818,300	9.34	2.22
1897.....	943,732	934,221	9.99	2.38
1898.....	1,078,113	1,245,269	10.22	2.43
1899.....	1,530,816	1,485,130	10.06	2.34
1900.....	1,563 928	1.519,811	12.27	2.92
1901.....	1,566,385	1,560,230	13.33	3.17

The syndicate produces, to a large extent, briquettes made from coal screenings, which require a matrix or binder of some plastic, inflammable material, and for this purpose 116,956 tons of mineral pitch were used, which cost, on an average, about $10.25 per ton, delivered.

It need hardly be said that the general use of briquettes for domestic fuel in a large, densely built city, as well as for generating steam in a number of electric generating plants and factories, must have a decided and beneficial influence in reducing the smoke, which, in most American cities, has become a persistent and oppressive nuisance. Berlin, although a busy manufacturing city, ranks as one of the cleanest and best kept in Europe. One of the first things usually noticed by American and English travelers visiting the German capital for the first time is the absence of that cloud of dusty smoke that overhangs so many towns and cities in our country. The reason for this lies in three facts: The preponderant use of coke and briquettes, which are practically smokeless; the skillful, scientific construction of boiler furnaces and chimneys; and, finally, the high standard of skill that is taught and enforced among firemen who stoke furnaces with coal for steam and manufacturing purposes. It is not every strapping laborer who can shovel coal who is permitted to stoke a boiler furnace in this country. Before he can assume such a charge he must be taught the theory and practice of economical, scientific firing, by which the coal is distributed in such a manner and quantity over the grate surface as to secure the most perfect combustion of its volatile elements. The Silesian coal used here in most large steam plants and factories is rich in bitumen and would rank below many of the bituminous coals of the United States, and yet the long, dense, trailing clouds of smoke from mill and factory chimneys, which are so familiar a sight in many American cities, are rarely seen in this section of Germany, where the indiscriminate shoveling of raw bituminous coal into the steam and other furnaces is considered an ignorant and wasteful proceeding.

Coke making in retort ovens, by which every element is saved and bituminous coal converted into smokeless coke and gas, is another important factor in German fuel economy and abatement of the smoke nuisance. If American municipalities beyond the economic range of anthracite are ever emancipated from their present vassalage to the smoke incubus, it will be through the enforced use of one or more of three forms of prepared fuel, *viz.*, coke and fuel gas made in closed ovens from bituminous coal, and briquettes made from lignite, peat and other inferior materials by processes which have been invented, tested and proven to be efficient by the older and more economical countries of Europe.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

A LARGE PLANT FOR MINNEAPOLIS—It is rumored that a plant which will cost some fifteen million dollars will soon be built by the Twin City Rapid Transit Company, of Minneapolis. Engineers have been looking over the ground for an available site for a power plant and it is expected that a development will be planned for some situation on the Missouri River.

TROLLEY COMBINE IN NEW JERSEY—It is understood that there is being formed in New Jersey an immense street railway combination. The deal will take in all the street railway systems of Hudson, Essex, Union, Passaic and other parts of northern Jersey, the middle Jersey system including Middlesex and Monmouth, the seacoast system, all the principal lines in southern Jersey and the lines on Staten Island. The scheme contemplates many changes and improvements, extension of roads and a tunnel under the kills from New Jersey to Staten Island.

BALTIMORE TUNNEL NUISANCE — Mayor Hayes has approved the ordinance recently passed by the city council, requiring the Baltimore & Ohio Railroad Company to substitute electric motors for the steam locomotives for hauling freight trains through the tunnel which passes under the main section of the city. The adoption of the ordinance is in response to the popular complaint that the locomotives threw such a quantity of smoke and cinders at the tunnel openings as to constitute a public nuisance. The Baltimore & Ohio company will comply with the ordinance as speedily as electric motors can be constructed.

NEW GERMAN ATLANTIC CABLE—The German Atlantic Telegraph Company in Cologne is issuing four per cent debentures to the amount of 20,000,000 marks to provide for the cost of laying a second cable between Germany and the United States, the present cable having already proved inadequate for the increasing traffic. A new agreement has, at the same time, been concluded between the company and the Imperial Postal Administration, whereby the company's privilege is extended until 1945, and the following stipulations are made: "Provided that by 1904 the second cable is ready, as far as the Azores, the Imperial Exchequer will pay the company for the year 1904 a fixed compensation of 750,000 marks, and provided that the whole cable is ready in January, 1905, the company will receive from the Exchequer a yearly subsidy of 1,710,000 marks until 1944."

INCREASE IN IMPORTS—An increase of $10,000,000 in imports of iron and steel manufactures, and a decrease of $19,000,000 in the exports of that class of articles is a striking characteristic of the commerce of the year just ended. Mr. James M. Swank, secretary of the Iron and Steel Association, explains this in his annual report in the following way: In 1899 and immediately preceding years, the iron and steel industries in Europe were exceptionally prosperous. There was an active demand and prices were high. In the years just prior to 1899 the prices of iron and steel in the United States were lower than ever before. Under these conditions we naturally found opportunities to dispose of our surplus iron and steel products in neutral markets, and even in the home markets of our European competitors. The activity of the export trade of iron and steel was exceptional and abnormal. Now, however, not only is Europe adopting our improved methods of manufacture, but will always have cheap labor, and by these agencies can hold its own markets, and actively and aggressively contend for the possession of neutral markets. It is stated on good authority that the low prices which have caused the reduction in iron and steel are due in part to excessive exportations of iron and steel manufactures from Germany, made at unusually low prices for the purpose of disposing of an accumulated surplus, and by the reduced home demand of that country.

AUTOMOBILES IN ALGERIA—The United States Consul at Algiers, Mr. Daniel S. Kidder, says: "Algeria is a country specially adapted to the use of automobiles, both on account of its excellent roads and the steep grades which prevail. As far into the country as roads are built, they are constructed with great care and kept continually in repair. Many of them are military roads adapted for the rapid movement of soldiers, including, of course, artillery and munitions, the railroad being wholly inadequate for such purposes. Other roads are almost as good, owing to the necessity of bringing heavy loads of wine from the vineyards of the interior to the seaboard. The city of Algiers has a population of 100,000, about one-half of whom are of Arabic descent and can not be considered as possible purchasers The other half, European birth and descent, according to the best obtainable estimate, own 900 automobiles and 300 moto cycles. The automobiles are exclusively of French manufacture. American machines have never been tried here, and it is therefore impossible to give an opinion as to the future prospects for American trade. Aside from a natural prejudice in favor of France, and also the absence of customs duties upon the French article, there is no reason why automobiles manufactured in the United States should not be sold here as bicycles and many other machines have been sold. Algerians are favorably disposed to American manufactures of all kinds, especially machinery. At present, freights from the United States to Algiers are very low. The newly established Levant Line gives bimonthly service between New York and Mediterranean ports. Application for rates should be made to the Hamburg-American Steamship Company, New York city."

TELEPHONE AND TELEGRAPH

CHESTER, PA.—Improvements are now being made on the lines of the United Telephone Company. An extension is to be made from London Grove south.

CHATTANOOGA, TENN.—It is stated that this city is to have a new telephone exchange within the next few months, owned and operated by an independent company.

NEWARK, N. J.—The Warwick Valley Telephone Company has acquired the right of way to Amity and Pine Island and will begin the erection of poles in a few weeks.

ROME, N. Y.—The Rome Home Telephone Company's line is being extended through Vernon Center to Knoxboro, and the line will be carried on to Oriskany Falls as soon as possible.

HASTINGS, NEB.—The Adams County Telephone Company has been incorporated and has applied to the council for a franchise. As soon as $32,000 worth of stock is sold, the new plant will be installed.

CHARLESTON, S. C.—The Southern Bell Telephone and Telegraph Company has begun the reconstruction of its system in this city, including the laying underground of all wires on the principal streets of the city, the establishment of a new system of battery in subscribers' stations, and general improvements.

SCHENECTADY, N. Y.—It is stated that a long-distance telephone system is to be constructed that will accommodate the great section of country between Buffalo and New York, running through the Mohawk Valley. The system will accommodate the whole interior and much of the northern part of the state. There will be two through wires between Albany and Utica.

ITHACA, N. Y.—The Wayne Telephone and Telegraph Company and the Lyons Telephone Company have been consolidated, forming the Wayne County Telephone Company. The capital of the new company is $50,000. It is announced that the contract for the construction of a toll-line service between Ithaca and Cortland has been signed, and it is stated that the line will be built and ready for use by September 1.

KORTRIGHT, N. Y.—The Davis Telephone Company has been incorporated, to operate between Delhi and other places in Delaware County; Worcester and other places in Otsego County; Cobbleskill and other places in Schoharie County; Delanson and Duane, Schenectady County; the villages of Altamont, Voorheesville, Slingerslands and Delmar, Albany County, and the city of Albany; also to Binghamton and places in Chenango and Broome counties. The capital of the company is $10,000, and the directors are: Ferris E. Davis, James K. Penfield, Andrew J. Nicholl, of Delhi.

ELECTRIC RAILWAYS

RICHMOND, IND.—It is stated that the extension of the Dayton & Western traction line from Eaton, Ohio, to this city will be built before the end of the coming winter.

TOLEDO, OHIO—The Toledo Railway and Light Company has announced that it will spend about $75,000 in improving its facilities in this city. Thirty acres of land have been acquired, and the construction of car shops and storage sheds will be commenced.

SHARON, PA.—The Cleveland & Sharon Traction Company has been incorporated and will build a trolley line between Cleveland and Sharon, a distance of eighty-five miles. The line will cost over $2,000,000. It will connect with a line from Sharon to Pittsburg.

PIERRE, S. DAK.—Articles of incorporation were recently filed for the Interstate Railway Company with headquarters at Canton, S. Dak. The capital stock of this company is $50,000,000, and the proposed line will extend from Duluth, Minn., to Galveston, Tex., with a branch up the Sioux Valley into North Dakota.

NEWARK, OHIO—At the recent meeting of the city council, an ordinance was introduced to grant a new franchise to the electric street railway company, whose present franchise has several years yet to run. The company is about to expend $100,000 in putting the road here in first-class condition, and before expending that sum the owners desire a new twenty-five-year franchise.

BALLSTON, N. Y.—The Hudson River Electric Company, according to a certificate filed recently in the office of the Saratoga County Clerk, has increased its capital stock from $1,000,000 to $3,000,000. This company is the owner of the mammoth new concrete dam at Spier's Falls. On September 1 the transmission of power to the plant of the General Electric Company at Schenectady will be begun.

AUSTIN, TEX.—The Austin City Street Electric Railway Company, recently taken out of the hands of the receiver, is to be greatly improved. The entire road will be reballasted, new ties and rails laid where needed, 500 tons of rails having been ordered and 400 more tons to be contracted for. Several extensions are contemplated, and one to the driving park assured. A new car shed and repair shop are to be erected.

RICHMOND, VA.—A road from Hamilton to Richmond and also from this city to Anderson is being planned by a company of promoters headed by Gus N. Hodges, of Dayton, Ohio. Falke Brothers, of Milwaukee, railroad contractors, have been granted a contract for the building and full equipping of the road from Hamilton to Richmond. The contract requires that the entire line shall be ready for operation by June 1, 1903.

LE ROY, N. Y.—Yale University, which owns over $50,000 worth of Main street property, has given consent for the Buffalo & Depew extension to pass its property. The trolley company has agreed to stand a large portion of the expense which will be incurred by the building of a new bridge and to keep a strip of pavement ten or twelve feet in width in proper condition from the west to the east end of the village. The advisability of granting a franchise will be discussed before long.

SAN FRANCISCO, CAL.—The North Shore Railroad Company, which lately authorized an issue of bonds amounting to $3,500,000, recently received subscriptions for $750,000 worth of the bonds. Among the improvements projected are the converting of twenty-five miles of steam railroad into an electric line—a third rail will be laid—a 2,000-horse-power steam electric station will be constructed. This is intended as a reserve station, but a part of the plant will be kept in operation all of the time in case of interruption of the current received from the Bay Counties Power Company's transmission line.

PITTSFIELD, MASS.—The incorporators of the New York & Berkshire Street Railway Company have perfected its organization and the following officers were elected: President, R. C. Taft, South Egremont; treasurer, William C. Dalzell, South Egremont; secretary, O. C. Bidwell, Great Barrington; consulting engineer, H. F. Keith, of Mount Washington. The proposed line is from Copake Lake, N. Y., to the Connecticut River at Springfield, a distance of sixty-five miles. It is understood that Mr. Whitney and Mr. Westinghouse are taking considerable interest in the proceedings, in view of the opportunity which the line will offer for experimental purposes.

SAN FRANCISCO, CAL.—The extension of the Oakland Transit lines on the east side of the bay south as far as San Jose means that there will be a belt about the whole bay from San Francisco to Oakland by way of this city. The United Railroads of San Francisco have announced that the San Mateo line is to be extended along the peninsula south through Redwood City, Palo Alto and Mountain View to this city as rapidly as possible. Franchises have been secured in San Mateo County as far south as the boundary line of this company, and the company is expected to soon ask for a similar privilege in this county. The construction of the line is assured, although the date of its completion has not been announced.

BANGOR, ME.—A remarkable expansion of the electric railway systems of Maine is projected. The line from Bangor to Hampden is to be extended seven miles further down the river to Winterport and there is a prospect that this road will run to Frankfort and down the bay to Fort Point and Belfast. The Penobscot Central line has been extended to Corinth, twenty-one miles from Bangor. Plans are also being made for a road from Augusta to Waterville and another connecting Augusta with Belgrade Lakes and Oakland. Companies having a capital stock of $200,000 each have been organized for the construction of these lines. A project in which Governor Hill is largely interested contemplates the construction of a road across the state from the Kennebec River to Penobscot Bay.

NEW INCORPORATIONS

ERIE, PA.—The Keystone Electric Company. $400,000.

SHARON, PA.—The Cleveland & Sharon Traction Company.

MAMARONECK, N. Y.—The Subway & Westchester Construction Company. $400,000.

NEW BEDFORD, MASS.—New Bedford Gas and Edison Light Company. Increased to $900,000.

HELENA, MONT.—The Helena Light and Traction Company. Increased from $100,000 to $250,000.

LITTLE ROCK, ARK.—Stuttgart Water and Electric Light and Power Company. Increased to $50,000.

ST. LOUIS, MO.—Portage Home Telephone Company. $10,000. Directors: H. D. Schofield, Claus Brink, E. G. Miller and others.

LOS ANGELES, CAL.—Etiwanda Power Company. $450,000. Directors: N. W. Stowell, George Chaffrey, A. M. Chaffrey, Rush Harris, J. W. Swanwick.

NEWARK, N. J.—The International Towing and Power Company. $100,000. Incorporators: Edward T. Magoffin, Millard W. Baldwin and Harry H. Picking.

ST. PAUL, MINN.—The Duluth & North Shore Telephone and Telegraph Company. $25,000. Directors: Arthur Howell, William Elder, E. Frankenfield, Eby Gridley and Leo A. Ball.

COLUMBUS, OHIO—The Toledo, Fayette & Western Railway Company. $10,000. Incorporators: Luther Allen, F. C. McMillin, C. M. Stone, F. E. Seagrave, C. E. French, C. F. Franklin, J. R. Seagrave.

MINEOLA, L. I.—Mineola, Roslyn & Port Washington Traction Company. $150,000. Directors: Isaac H. Odell, Frederick H. Parker, Reinbold Fr. Dorn, Gardner P. Harrington, Jacob Besant, John A. Fitzpatrick, Walter H. Barrett and James J. McCabe, all of New York city.

ALBANY, N. Y.—The Richmond Street Railway Company. $190,000. Directors: Waldo S. Reed, Englewood, N. J.; William T. Newkirk, Paterson, N. J.; Cornelius W. Van Voorhis, Mariner's Harbor; Frank J. Hammer, De Witt V. D. Reilly, James F. Leavy, Brooklyn; Robert P. Barry, Jr., Henry M. Haviland, New York, and John B. Summerfield, Queens.

DES MOINES, IOWA—District Telegraph Agency. $1,000. Directors: T. P. Cook, F. H. Tubbs, W. J. Lloyd, J. F. Morgan, C. F. Patterson, all of Chicago. The officers are: T. P. Cook, president; F. H. Tubbs, vice-president; M. M. Thorp, secretary; J. H. Pendry, treasurer, also of Chicago. The incorporators are: W. H. Dolebear, J. W. Smith, and W. E. Mason, of Des Moines.

INDIANAPOLIS, IND.—The Indianapolis Terminal and Traction Company; $500,000; incorporators: Hugh J. McGowan, John D. Thomson, James M. Jones, Clarence Winter and W. Kesley Schoepf. Ohio & Indiana Construction Company; $600,000; directors: Herbert C. Paul and Stephen B. Fleming, of Fort Wayne; S. T. Murdock, of La Fayette; Lemon G. Neely, of St. Mary's, Ohio; J. W. Van Dyke, of Lima, Ohio.

ELECTRICAL SECURITIES

The stock market continued in a more or less flourishing condition all during the week, and further bullish manipulation was manifest, and the fine agricultural outlook as indicated by government reports has resulted in a very satisfactory expansion of general operations. The upward movement has met with very little opposition, and the reassuring monetary outlook has helped considerable realizing during the week. This condition is all the more satisfying, as the drawing to a close of the summer season bids fair to find the outside speculative public taking a decided interest in a condition which, in that period which should have shown the greatest depression, has held so strong. With the coming of the cool season will begin the return of many interests of a speculative nature to the market, and the outlook is for a continued successful session.

The losses resulting from the protracted labor controversies in the coal strike situation are totalling into enormous figures, and the end of this serious situation is apparently far off. From time to time there are rumors extant which predict the early crisis of this affair, and with the coming of the cold season the condition is becoming one of very material consideration.

ELECTRICAL SECURITIES FOR WEEK ENDING AUGUST 16.

New York:	Closing.
Brooklyn R. T.	66⅞
Con. Gas	222½
Gen. Elec	185
Kings Co. Elec	202
Man. El	134¼
Met. St. Ry	147⅞
N. Y. & N. J. Tel. Co	175
Westinghouse Mfg. Co	226
Am. Union Electric Co	13¾

New York & New Jersey Telephone stock sold during the week at 180. The highest price for this stock during 1901 was 180¼, and the lowest, 160. For Kings County Electric Light and Power, 202 has been offered, with 208 asked.

Boston:	Closing.
Am. Telep. & Tel.	167¼
Edison Elec	280
Mass. Elec. pf	97½
New England Tel	141½
Western Telephone & Telegraph	105½

For the first time since its formation, the earnings of the Massachusetts Electric Company show a monthly decrease in June gross earnings, which amount to $577,362, a falling off of $8,048 compared with the same period in 1901. Indications are that July earnings will about equal those of a year ago, of about $650,000. Gross earnings of the Massachusetts Electric Company since January 1 are $2,635,504, as compared with $2,499,601 for the same period of 1901. There was a slight advance in American Telephone and Telegraph on considerable buying during the week, and also a good demand for Edison Electric Illuminating.

Philadelphia:	Closing.
Elec. Co. of America	8⅝
Elec. Stor. Bat. c	90
Elec. Stor. Bat. pf	90
Philadelphia Elec	6¼
Union Traction	47
United G. I. Co	109

Chicago:	Closing
Chicago Edison Light	175
Chicago Telep	165
Metropolitan El. pf	110
National Carbon	31¾
National Carbon pf	100
Union Traction	16¼
Union Traction pf	52

ELECTRIC LIGHTING

JORDAN, MINN.—The common council has voted to raise money for the construction and operation of a city lighting plant, by the issuance of short-term bonds, which will be purchased by local money.

BALLSTON, N. Y.—The Hudson River Electric Company, which controls the electric and water-power companies in this vicinity, has given to the Morton Trust Company three supplemental mortgages to secure the issue of $5,000,000 in gold bonds.

READING, PA.—Philadelphia and Reading capitalists have organized the Reading Power Company, and will erect a $1,000,000 plant. It is the purpose of the company to supply not only the city with power required, but also every town and borough in Berks County.

DALLAS, TEX.—The plant and other properties of the Dallas Electric Company were sold at the United States Receivers' sale recently for $300,000 to representatives of the bondholders of the old Dallas Electric Light and Power Company. The purchasers are Boston capitalists.

WASHINGTON, D. C.—The Water Motor and Power Company is said to be planning to erect a large power-house at Great Falls, on the Virginia side. The company was recently incorporated under the laws of the state of Delaware with a capital stock of $1,000,000 for the purpose of supplying power to manufacturing plants. It expects to furnish enough power to run many of the Washington industries, including street car lines, lighting plants, etc.

NASHVILLE, TENN.—George L. Beech and W. W. Fairbanks have closed a transaction with Waters, Rogers & Christian, representing Chicago and New York capitalists, for the transfer of the latters' rights in the water power at Horseshoe Falls on Caney Fork River, thirteen miles from McMinnville, Tenn. The purchasers will at once organize a company to develop this force, which is estimated at 20,000 horse-power, and which is to be utilized for furnishing electricity to Nashville and immediate points for heating, lighting and cooking purposes. It is intimated that the company may build an electric line from McMinnville to Nashville.

EVANSTON, ILL.—The Evanston Electric Illuminating Company has been purchased by Mr. Samuel Insull. This company has been owned for a number of years by the Westinghouse Electric Company, and supplies Evanston with electric light. With this purchase Mr. Insull becomes the owner of all the electric lighting plants in the important cities along the lake shore from the city limits to the Wisconsin state line, a distance of between fifteen and twenty miles. Exceptions to the ownership of Mr. Insull are a small plant at Evanston and a small plant at Winnetka. Mr. Insull is president of the Chicago Edison Company, but that company, it is said, has no interest in the lake shore electric plants which have just been purchased.

PERSONAL MENTION

PROFESSOR FRANCIS B. CROCKER, of Columbia University, is spending a long holiday in Colorado and the western states.

MR. WILLIAM COLE, of the Sterling Electrical Manufacturing Company, Warren, Ohio, has left for an extended trip to the Pacific coast.

MR. JOHN ALLEN HAINES, president of the Haines & Noyes Company, Chicago, has been in New York at the Hotel Savoy for the last few days.

MR. R. E. GALLAHER, the general manager of the New York Insulated Wire Company, is recuperating from a serious attack of gastric fever at the Thousand Islands.

MR. N. F. BRADY, first vice-president of the New York Edison Company, proposes to spend a month or two in European travel, leaving recently on the Celtic for England.

MR. C. O. BAKER, of Baker & Company, platinum refiners, Newark, N. J., has been elected a member of the board of directors of the National State Bank of Newark.

MR. J. K. ROBINSON, agent for the Westinghouse Electric and Manufacturing Company, will hereafter be addressed at Iquique, Chili. Mr. Robinson has sailed from New York for that city.

MR. E. LEC. HEGEMAN, a young New York electrical engineer, has sailed for Chili, to be associated with Mr. J. K. Robinson, in the Westinghouse interests on the western coast of South America.

MR. CHARLES F. SCOTT, chief electrician of the Westinghouse Electric and Manufacturing Company, and president of the American Institute of Electrical Engineers, has just returned from England, where he has been spending the last few months engaged on important engineering work.

PROFESSOR G. F. SEVER, of the electrical engineering department of Columbia University, it is announced, has been selected as consulting engineer of the Greater New York Department of Gas and Electricity. This is one of the best appointments in the gift of Colonel Monroe, the commissioner, and carries a very comfortable salary appropriation.

OBITUARY NOTICE

MR. W. A. SCOTT, president of the Illinois Wire Company, died in Chicago on August 9. Mr. Scott until recently was president and owner of the Marshfield & Southeastern Railroad and the Scott Lumber Company. He was forty-three years old, and is survived by a widow and one son.

INDUSTRIAL ITEMS

THE CONTINUOUS RAIL JOINT COMPANY OF AMERICA has transferred its English account to Mr. L. P. Wimby, 20 King William street, London, E. C.

THE LOWELL WRENCH COMPANY, Worcester, Mass., is meeting with a great demand for its popular lag screw wrench. This is an excellent tool for railway work, besides having an almost universal application. A. W. Secor, 110 Liberty street, is the New York agent.

SARGENT, CONANT & COMPANY, Boston, Mass., have secured the contract for the entire mechanical and electrical equipment for the new plant at Philadelphia of the Crompton & Knowles Loom Works, of Worcester. Power for the entire works will be developed and distributed electrically.

COLONEL S. G. BOOKER is establishing an office at 405 Fullerton Building, St. Louis, Mo., as a manufacturers' agent in electrical and allied industries. Colonel Booker is well known throughout the electrical industry, having been a pioneer in the manufacture of carbon products.

PARKE, DAVIS & COMPANY, Detroit, Mich., the well-known manufacturers of drugs and chemicals, are making extensive additions and improvements to their electrical, steam and power plant. The work is being done under the direction of Mr. George W. Scott, consulting engineer, the Rookery, Chicago.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Cleveland, Ohio, reports an unusually good business for the summer months, and the securing of several substantial contracts for export based upon the most rigid competitive tests seems to bear out the claims of the manufacturer, that the Sunbeam lamp is an excellent product.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is distributing a new general supply catalogue (No. 16), a new telephone and telephone supply catalogue (No. 17), and a new catalogue of Gutmann alternating-current wattmeters. The company also distributes a new catalogue showing a full line of rubber-covered wires and cables.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., is distributing its illustrated sectional catalogue No. 141 on A B C pressure and volume blowers. The book is handsome in appearance and is very complete in its descriptions and illustrations of this company's product. Considerable literature of an engineering nature is added, which greatly increases the value of this fine reference catalogue.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., manufactures many appliances for electrical heating. One of this company's specialties is the electrical shoe ironer. This gives a constant and steady heat, which can be regulated to the desired degree for the different grades of leather. A rheostat regulates the heat, and there is no danger from fire. This is said to be a very serviceable and reliable implement for its special work.

THE UNION SWITCH AND SIGNAL COMPANY, Pittsburg, Pa., is mailing its 1902 catalogue, section I, mechanical interlocking machines and ground lever stands. This book will be found of great interest and value for all railway men. It is this company's intention to issue a very complete set of catalogues for 1902 in sections; one section illustrating fully mechanical appliances, another electro-pneumatic appliances, and another distinctive electric appliances. These will be sent to any one interested upon request.

THE DIELECTRIC MANUFACTURING COMPANY has been incorporated at St. Louis for the manufacturing and testing of materials for electrical insulation. This company is putting on the market an insulating compound which is called "Dielectrol," for winding armature coils, field coils, instrument coils, arc lamp coils and transformer coils, or making any kind of connections. The compound may also be used for insulating wood or iron. Mr. J. J. Kessler, Jr., is the general manager. Information and samples for inspection will be furnished upon application.

WESTINGHOUSE, CHURCH, KERR & COMPANY announce the removal of the New York office from the Havemeyer Building, 26 Cortland street, to the Maritime Building, Nos. 8 to 10 Bridge street, opposite the new Custom House and near Bowling Green. This change is the result of a largely increased business. The first, second and third floors will be devoted to the office uses and the new quarters will afford about double the floor space available in the present location. The future official address will be Westinghouse, Church, Kerr & Company, 8 and 10 Bridge street, New York city.

MR. G. M. GEST, electrical subway contractor, 277 Broadway, New York city, is finishing a contract for 1,250,000 feet of conduit covering forty miles of street for the Cincinnati Gas and Electric Company. An abstract from a Cincinnati paper endorses very conclusively Mr. Gest's work upon this contract, stating that the whole work has been done most expeditiously and that considering the shortness of time after the contract between the company and the city was signed until the work was required to be finished it was carried on with a minimum of inconvenience to the public and a remarkable rapidity.

THE STANDARD POLE AND TIE COMPANY, 44 Broad street, New York city, has recently opened another cross-arm mill in the South. This company has a large stock of standard arms already milled and the facilities for turning out arms according to special specifications are excellent. All arms are carefully inspected before shipment is made and even the smallest defect is deemed sufficient reason why the arm should not be shipped. Among regular customers for cross-arms are the General Electric Company, the Central New York Telephone and Telegraph Company, the Empire State Telephone and Telegraph Company, the Hudson River Telephone Company, and the Diamond Electric Company, of Philadelphia.

ROSSITER, MACGOVERN & COMPANY, 141 Broadway, New York city, have issued a very complete catalogue describing their stock of electrical and steam machinery. Since the last issue of this booklet the facilities for handling business have been largely increased. By the opening of two branch sales offices—one in Boston, at 100 Milk street, and one in St. Louis, in the Missouri Trust Building—this company is now enabled better than before to handle all New England and western business in a thorough and systematic manner. The warehouse capacity has been greatly increased, and the electrical warehouses and repair shops in Jersey City have had shipping facilities added, and showrooms in both Boston and St. Louis have been acquired, where a large stock of machinery is constantly kept on hand. The book is carefully indexed, and will be sent to any one requiring immediate shipment of any description of electrical and steam apparatus.

AMONG THE MOST recent contracts closed by the Electric Storage Battery Company, of Philadelphia, for chloride accumulators in railway service are the following: Providence & Danielson Railroad, Providence, R. I., 107 kilowatts; Mahoning Valley Railway Company, Youngstown, Ohio, 351 kilowatts; Kansas City-Leavenworth, Wolcott, Kan., 160 kilowatts; Detroit United Railway, Detroit, Mich., 172 kilowatts; Connecticut Railway and Lighting Company, Derby, Ct., 175 kilowatts; Los Angeles & Pacific Railway Company, Los Angeles, Cal., 126 kilowatts; Harrisburg Traction Company, Harrisburg, Pa., 294 kilowatts; Eastern Ohio Traction Company, Gates Mill, 259 kilowatts; East Bangor, Portland & Delaware River Railway Company, East Bangor, Pa., 87 kilowatts; Greenville & Turner's Falls Street Railway Company, Cheapside, Mass., 81 kilowatts; Capital Traction Company, Washington, D. C., 173 kilowatts; Consolidated Railway Lighting and Power Company, 119 kilowatts; York County Traction Company, Red Lion, Pa., 99 kilowatts; Orange & Passaic Railroad Company, Orange, N. J., 209 kilowatts; Portland & Brunswick Street Railway Company, Brunswick, Me., 72 kilowatts; Milwaukee Electric Railway and Lighting Company, two batteries aggregating 1,700 kilowatts; Ottawa Electric Railway Company, Ottawa, Ontario, 599 kilowatts; Danville, Paxton & Northern Railway Company, Georgetown, Ill., 65 kilowatts, and an increase of fifty per cent has also been made in the Peekskill Light and Railway Company's battery which originally consisted of 87 kilowatts. Other contracts recently closed embrace a battery of 8,000 amperes at 120 volts for the Edison Electric Illuminating Company of Brooklyn; a residential plant for C. Ledyard Blair, Far Hill, N. J.; batteries for the Wolvin Building, Duluth, Minn.; John D. Rockefeller for the West Side Neighborhood House, New York; Merck & Company, factory at Rahway, N. J.; John R. Sherman, residential plant, Fort Henry, N. Y.; J. Hurst Purnell, office building, Baltimore; Hanover National Bank, New York; New York Stock Exchange; J. Samuels & Brother, of Providence, R. I.